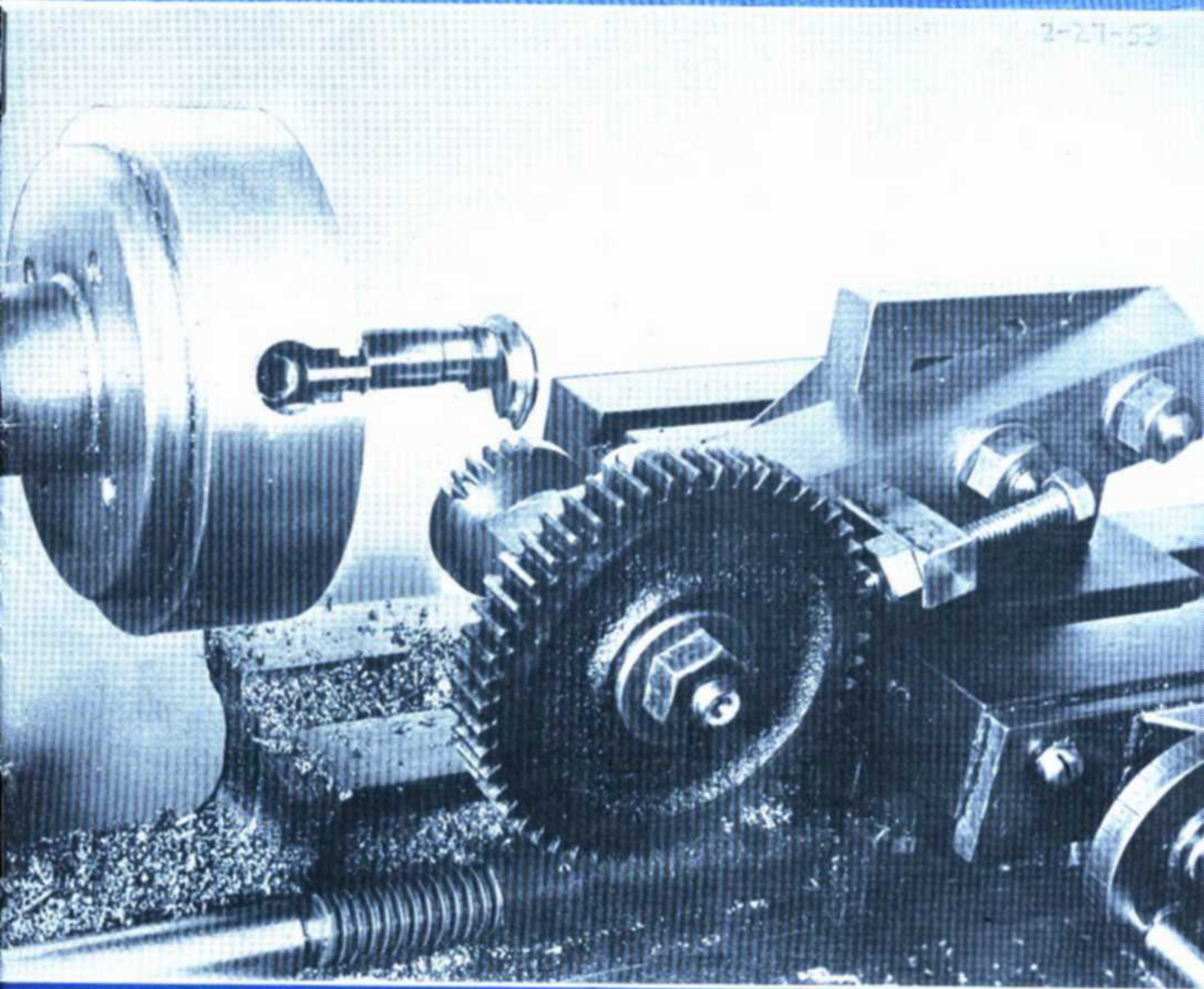
THE MODEL ENGINEER

2-27-53



IN THIS ISSUE

● A ½-in. SCALE GRESLEY PACIFIC ● SIMPLE METHOD OF CUTTING GEARS ● COMPONENTS FOR RADIO CONTROL ● CUTTING CLOCK WHEELS ON A SMALL LATHE ● QUERIES AND REPLIES ● ADDITIONS TO A DRILLING MACHINE

FEBRUARY 12th 1953
Vol. 108 No. 2699

9ᴰ

THE MODEL ENGINEER

EVERY THURSDAY

Volume 108 - No. 2699

FEBRUARY 12th, - 1953

ESTABLISHED 1898

PERCIVAL MARSHALL & CO. LTD. 19-20 NOEL STREET · LONDON · W·1

CONTENTS

Our Cover Picture

Among the many and varied functions which the model engineers' lathe is called upon to cope with, that of cutting the teeth of gear wheels is one of the most interesting. The problem of adapting a simple lathe for this purpose has been tackled in various ways by our readers and all the methods have achieved their desired end. In some cases, the lathe is used as a dividing engine by the attachment of some form of indexing device to the mandrel, and the cutter spindle mounted in some way on the slide-rest and driven from overhead gearing or other convenient source of power. This is the method employed by Mr. J. C. Stevens, in his series of articles, the conclusion of which is published in this issue. It enables the gears to be cut while set up for the initial turning processes, and eliminates the risk of errors due to resetting. In other cases, the cutter is driven by the lathe mandrel and the dividing done by an attachment, carrying the gear blank, on the slide-rest. With this method, the full range of power and speed of which the lathe is capable can be applied to the cutter, and it is preferred for larger and heavier work. Our illustration shows a gear being cut by the latter method, as described in an article by Mr. L. C. Mason in this issue.

SMOKE RINGS

Free-lance Locomotives

WE ARE sometimes accused of being biased against that class of model locomotive which is called " free-lance " just because it is not a straight copy of any particular full-size prototype, and we have even heard it said that Mr. So-and-so decided not to send his model in to the " M.E." Exhibition simply because he " knew it did not stand a chance, as it was his own design."

Ideas such as these show a complete misunderstanding of the matter and could scarcely be farther from the truth. Let us be frank about it and make quite plain that the only type of free-lance model that we are against, no matter whether it is a locomotive, ship, motor-car, stationary engine, or *any* other type of model, is the one that betrays its builder's lack of knowledge of the fundamental basis of the design of the prototype. Unfortunately, so-called free-lance models of this sort are in the majority, many of them clearly revealing that their builders have not taken the least trouble to study the underlying principles of prototype design and practice. Too often, such models also reveal, quite clearly, that the builders, through either laziness or ignorance, have taken " short cuts " for the deliberate purpose of dodging some allegedly awkward problem of design or construction. Such as these are condemned ; but otherwise a free-lance model can win just as much distinction and approbation as the best true-to-scale " prototype " model, as last year's Cup-winning locomotive at the " M.E." Exhibition proves conclusively.

Richmond Railway Exhibition

TO DRAW public attention to the of railway services at Richmond, Surrey, an exhibition was staged by British Railways, Southern Region, during the week ended January 24th. It took the form of a display of documents, pictures, relics, models and certain items of full-size equipment appropriate to the occasion, and attracted a large number of visitors. The old London & South Western Railway was, of course, primarily featured ; but the other constituents of the later Southern Railway—i.e. the London, Brighton & South Coast and the South Eastern & Chatham, as well as the North London Railway and the Metropolitan District line, were fully represented.

Most of the photographs were of very great interest, reviving, as they did, memories of scenes and services that are now almost forgotten. For instance, one of them showed a District Railway steam train crossing over to the Great Western main line at Ealing, recalling the useful but short-lived District service from Mansion House to Windsor. Many of the models were official property, but we noted a considerable number on loan from the Model Railway Club and the Wimbledon Model Railway Club. Mr. F. W. Bush's very attractive " O "-gauge working layout based on L.S.W.R. practice was a very prominent exhibit and, as usual, created a great deal of interest.

Apologium

WE MUST blame the move to our new offices for the extraordinary error that occured in the heading of " L.B.S.C.'s " article in our January 29th issue. The details described in the article are not for *Britannia* at all, but for the *Canterbury Lamb*. Fortunately, the list of contents on page 127 makes this clear ; but there was evidently a pernicious gremlin at work in the editorial office while the page-proofs were being read !

Errors of this kind very seldom occur, and in this instance we can only offer an apology to " L.B.S.C." and to any reader who may have been misled. If peace and freedom from disturbance are not forthcoming when page-proofs are being read, there is no knowing what might happen ; further, the original make-up for the January 29th issue carried the correct heading, and what escaped notice was that the printers had used the wrong block for the page-proofs.

Components for Radio Control

BY RAYMOND F. STOCK

The final part of a series dealing with the electrical and mechanical details from the constructor's aspect

WHEN the unit is completed, the first step in adjustment is to bend the fingers of the two contact arms until they each bear evenly along a good line contact with all of the static contact-pieces. The tension should be such that the fingers are deflected about $\frac{1}{16}$ in. in an axial direction as they "climb" on to a contact. The two long static contacts should press firmly and evenly upon the copper discs.

Adjustment is then similar to that described for the steering selector, the tension in the return spring being adjusted until it is sufficient to move the wiper assembly positively but with the minimum momentum (and therefore overshoot).

It should be found that 9 volts is ample to operate either of these selectors.

If it is desired to increase the number of positions in this motor sequence the remarks made previously apply, and a twelve-tooth wheel should be regarded as a minimum. Thus, if six positions were required, a suitable arrangement would be six contacts in each bank, three wiper arms (or four) and 18 teeth (or 24) on the wheel.

Fig. 11 is a photograph of the completed selector.

Concluded from page 167, *February* 5, 1953.

Assembly of Components

To prevent untidy wiring in the model and to facilitate servicing, it is very convenient to make all three units so far described fit upon a common frame. The inter-unit wiring (for a typical case) has been given in Fig. 4, and Fig. 12 is a photograph of a complete assembly made up on a wooden base measuring 7 in. by $4\frac{1}{4}$ in. This is intended to fit transversely in the stern of a power boat, when the push-pull rod is in a convenient position to link up with the rudder head. If rigorous conditions are expected, the three control units might be made up inside a watertight aluminium can with only the plugs and the output shaft projecting through the skin.

Conveniently sized plugs and sockets are those sold by radio dealers for making battery connections in "all-dry" receivers.

It is a wise precaution to "suppress" the motor and fit spark quench circuits across contacts, as otherwise the control mechanism may trigger off the receiver.

The assembly in Fig. 12 is so fitted. Two 0.1 mF condensers in parallel are soldered across the motor terminals while each pair of contacts is fitted with a 0.1 mF condenser in series with a 100 ohm resistor across it.

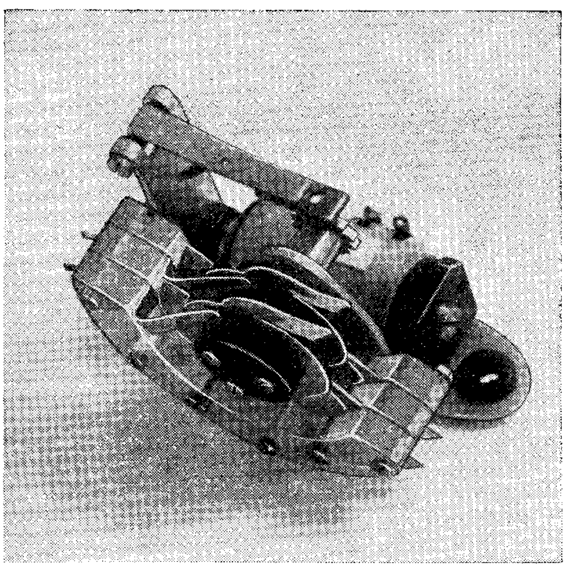
In the case of the selectors a common 100 ohm resistor is connected to each wiper arm, and separate condensers run to each of the static contacts concerned.

Alternative Uses

As mentioned previously the various components described can be used in many different ways.

The motor driven actuator has sufficient power for almost all applications and in place of the simple limit switches it can have a contact drum fitted to the output lever.

By arranging a number of spring leaves to bear on the drum, each supplied from a selector contact, the actuator can be stepped to



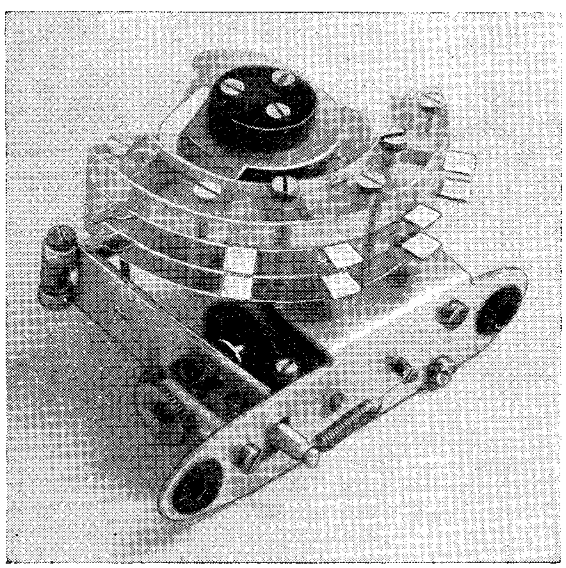


Fig. 11. The complete motor selector

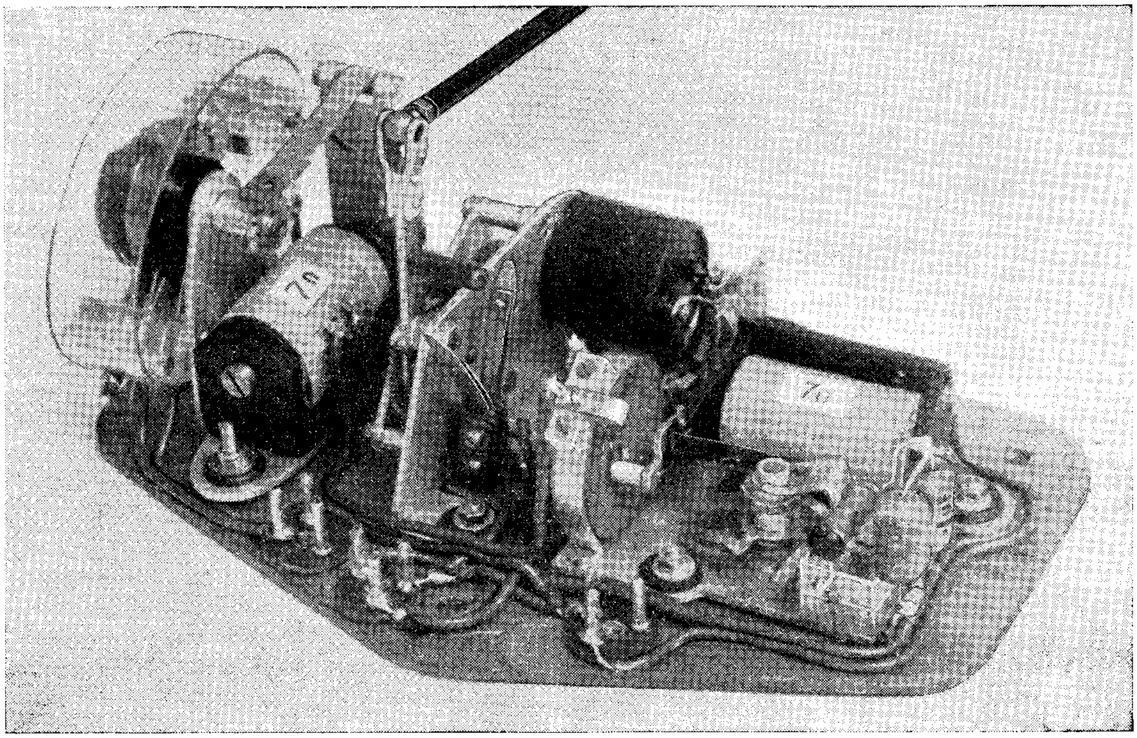


Fig. 12. The three contro. units mounted together. The resistor and condensers are spark-quench circuits

almost any number of positions.

The basic design of the steering selector can, by varying the number of positions, be used for sequential steering systems of a different class, and where each position corresponds with a given rudder position.

Probably the component subject to most variations would be the motor selector. It has been shown switching a permanent magnet main-propulsion motor through a simple series of positions, and these could be multiplied by using further resistors to give additional speeds ahead and astern. If a wound-field motor is used for propulsion the armature only is connected as indicated, the field being permanently connected to the source of power. In this case, however, it is necessary to break the field circuit in the " stop " position(s) to avoid wasting power and this requires an extra wiper arm and bank of contacts in the motor selector. Alternatively, if only one stop position is required an economy of effort is effected by fitting a cam to the ratchet wheel shaft to open a pair of contacts in the " stop " position.

When means of propulsion other than an electric motor are contemplated the position becomes more complex.

In a steam installation one could use the motor selector to operate another motor driven actuator, and couple the output lever to a plug cock in the steam line. This would enable " off " and " full on " to be positively obtained (by use of the limit switches) and probably some degree of control on a time basis could be obtained over the degree of opening.

A reversing cock or lever could be operated by another similar actuator, while two actuators controlled by a common motor selector could together operate both throttle and reversing functions.

The ignition lever of a petrol engine can be treated in the same way, and, in the more flexible four-stroke " multis," the throttle control.

If a satisfactory clutch can be fitted to an i.c. engine then only a simple two-way selector is required for control, and it is unnecessary to make the rotary type as described above. A simpler device as mentioned on page 323 of THE MODEL ENGINEER, No. 2676, will suffice. I consider that with the exception of the reversing function a very good control can be maintained over an i.c. model using only a clutch as the engine control. By slipping the clutch in and out, a fair degree of control over the speed of the model can be obtained, the inertia of the boat preventing an undue jerkiness from becoming apparent. Mechanical clutches require rather a lot of power for withdrawal, but experiments are currently proceeding to ascertain whether a practical electromagnetic clutch can be developed.

Power Supply

If an electrically propelled model is used, sufficient power for the selectors described is readily available. The designs are based on the assumption that either four or six secondary cells are in use, giving 8 and 12 volts on the electromagnets and 4 and 6 volts at the actuator motor. The latter voltage is too high for some small motors and a (roughly) 7 ohm resistor would be inserted in the lead between motor and wiper arm.

When steam or i.c. power is used, miniature accumulators would be ideal for a local power supply but dry batteries can be used to cut the

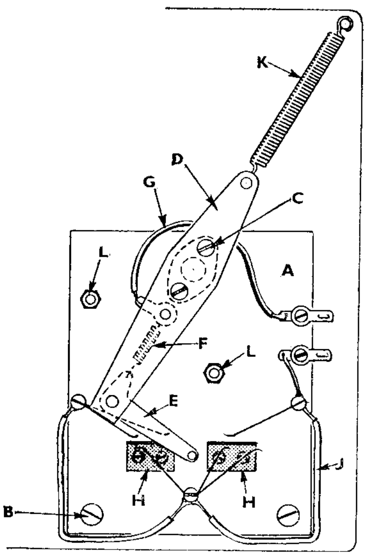


Fig. 13. Steering control fitted inside control box. The Perspex panel is 3 in. high

initial expense. A 9V grid bias unit centre tapped at 4.5 V will work steering selector actuator and a simple two-way motor selector for a reasonable period but a larger battery is required for the complete gear shown in Fig. 12. A maximum consumption of over 2 amps can be expected (in pulses) and a larger type of dry cell such as is used in cycle lamp batteries is required. Three of these batteries may be used in series to give 9 volts, and this again should be regarded as a minimum supply.

Operator's Control

The principle of the manual pulsing device has been explained in Fig. 2, and Fig. 13 is a view on the underside of the operator's control box. Panel **A** is of perspex $\frac{1}{4}$ in. thick and held to the control box case by two screws **B** and an externally screwed brass bush at the top. The latter supports a $\frac{1}{4}$ in. diameter steel control knob shaft which terminates in an oval flange on the inside. Bolted to this by the two 6 B.A. screws **C** is a $\frac{1}{4}$ in. thick perspex arm **D**.

This carries, pivoted to its tip, the link **E** of about 20-g. brass sheet. Riveted to the end of this swinging member is a peg 3/32 in. diameter, and projecting $\frac{1}{8}$ in. from the link towards the perspex base.

E is pivoted $\frac{1}{16}$ in. clear of **D** to permit spring **F** clearance. The other end of **F** is soldered to a 6 B.A. screw in the arm. From this point a stranded (insulated) conductor **G** leads to one of the connection tags.

H is a small angle bent from brass sheet, the perpendicular portion being $\frac{3}{16}$ in. high. Arm **D** is supported about $\frac{3}{8}$ in. above the base panel **A** so that while link **E** clears the top of **H**, the peg must interfere with the angle pieces by nearly $\frac{1}{8}$ in.

All the contacts are cut from hard silver or copper, the strips being 3/32 in. wide and supported in slots in small pillars screwed into the base panel. They are retained by soldering and a common wire is similarly connected and forms the second connection **J**.

The shape of the contacts is roughly that shown in Fig. 13, but is actually adjusted by experiment. It is not necessary to use the radio link at this stage, and the two connections from the control box can be connected directly to the input of the selector.

As the arm **D** is rocked through its three positions, the selector should respond instantly and correctly. If it fails to do so (and assuming selector and batteries to be beyond suspicion) it may be that the contact strips shown in Fig. 13 are not making adequate contact with the peg; this may be due to their being too weak or because they intersect insufficiently with the path of the peg. The pairs of contacts may show another fault by operating the selector only once for each pair and this is due to the spacing between each member of a pair being too small, thus giving the selector insufficient time to recover.

Once adjusted the control will give no trouble, and a spring **K** (Fig. 13) may be fitted to centre the arm.

Two pillars **L** are screwed into the perspex panel to limit the movement of the arm; at its extreme positions the peg must be well clear of the ends of the angles **H** or there is a danger of it returning to centre along the wrong path.

Impelled by spring **K**, the arm will move very rapidly back to its centre position, but if made correctly the selector should have no difficulty in following even the double impulses.

Any form of plastic control knob can be used on the outside of the control box; the box itself is indicated in Fig. 13.

Clockwork Control Unit

Fig. 14 illustrates the mechanism. **A** is a spring motor and on its

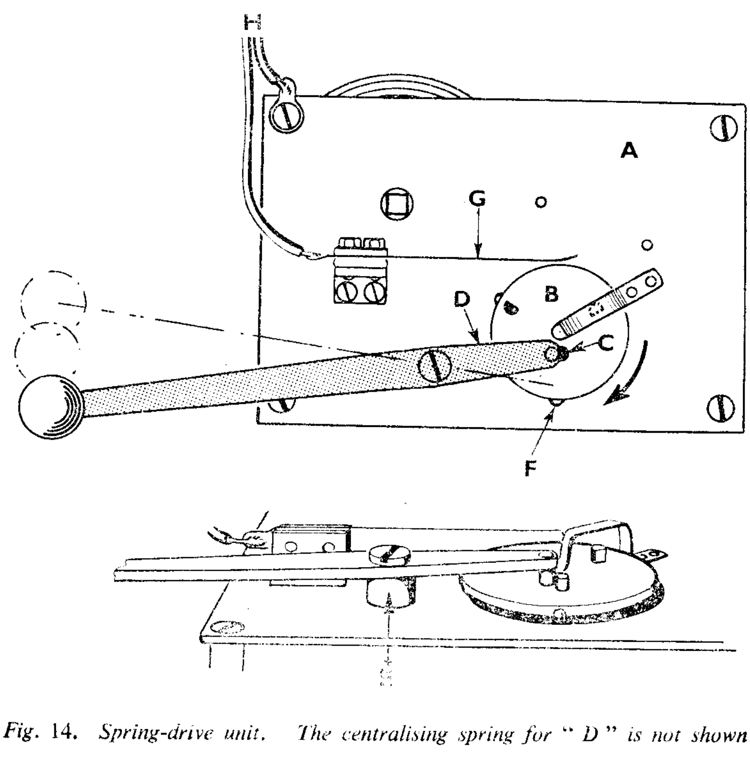


Fig. 14. Spring-drive unit. The centralising spring for " D " is not shown

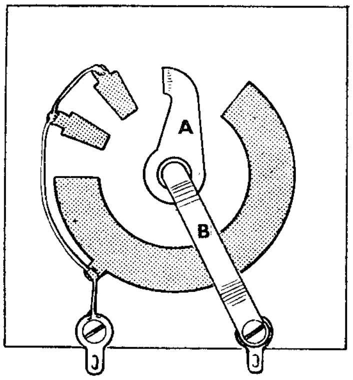


Fig. 15

output shaft is mounted the disc **B** made from 3/32 in. brass sheet and about one inch in diameter. Riveted to this disc are three steel pegs **C** placed 120 deg. apart and on three different pitch circles.

A lever **D** terminating outside the control box in a knob is pivoted on a pillar **E** in such a way that its shorter arm overhangs the disc; a stop-pin riveted to the underside of **D** interferes with the pegs and prevents the disc rotating by holding one or other of the pegs.

The control arm is normally centralised by a spring, in which position it holds the peg on the central pitch circle. When moved either to port or to starboard it releases the centre peg and permits the disc to rotate by either 120 deg. or 240 deg. Three contacts **F** are placed at 120 deg. on the periphery of the disc and as the disc rotates these pass successively under the static contact **G**. The latter is supported by an insulated bracket from the frame of the motor and is connected to the transmitter keying leads at **H**.

The other lead is taken to the motor frame and a good contact with the pulsing disc is ensured by a springy brass wiper arm bearing on its centre. It will be seen that this device ensures either one or two pulses being correctly sent according to which way the control knob is moved. The control arm must have its movement limited so that at its extremes of travel the stop at its end coincides with the outer and inner pitch circles of the pegs **C**.

The three pegs and the stop pin can all be turned from mild or silver steel; the former are filed flat to a diameter facing the direction of rotation as shown.

These pegs (and the stop pin) can be $\frac{1}{8}$ in. diameter, in which case the three pitch circles should be spaced at $\frac{1}{8}$ in. intervals, e.g., $\frac{3}{8}$, $\frac{5}{8}$ and $\frac{7}{8}$ in. diameter.

The three contacts on the rim of the disc are small silver pegs inserted and soft soldered into holes; **G** should also be of springy silver or other suitable contact material.

The spring mechanism can be taken from an old clock (by discarding the escapement) and where no shafts project beyond the motion plates it is quite simple to fit the pulse disc between the frames and to mount the lever **D** on the inside of a frame. In this case the diameter of the disc may well be limited by the available space between spindles.

In many cases a spring mechanism from an old toy or model can be pressed into service; with any motor it is necessary to judge which shaft the disc should be attached to. It is desirable to retain as high a gear ratio as possible from the spring to minimise winding, but naturally sufficient torque must remain to enable the contacts to key the transmitter effectively, and without slowing down the disc too much, or control will be sluggish. It is a good point to retain at least one wheel geared *up* from the pulsing shaft, and, perhaps, to fit a fan brake; otherwise trouble may occur from the contact action being too rapid and preventing an adequate pulse being sent.

The motor can be wound from the outside of the operator's control box and presents no problem; it is unlikely to be a frequent occurrence. The control can be made very light and is pleasant to use since it must be positive. However

(*Continued on page* 197)

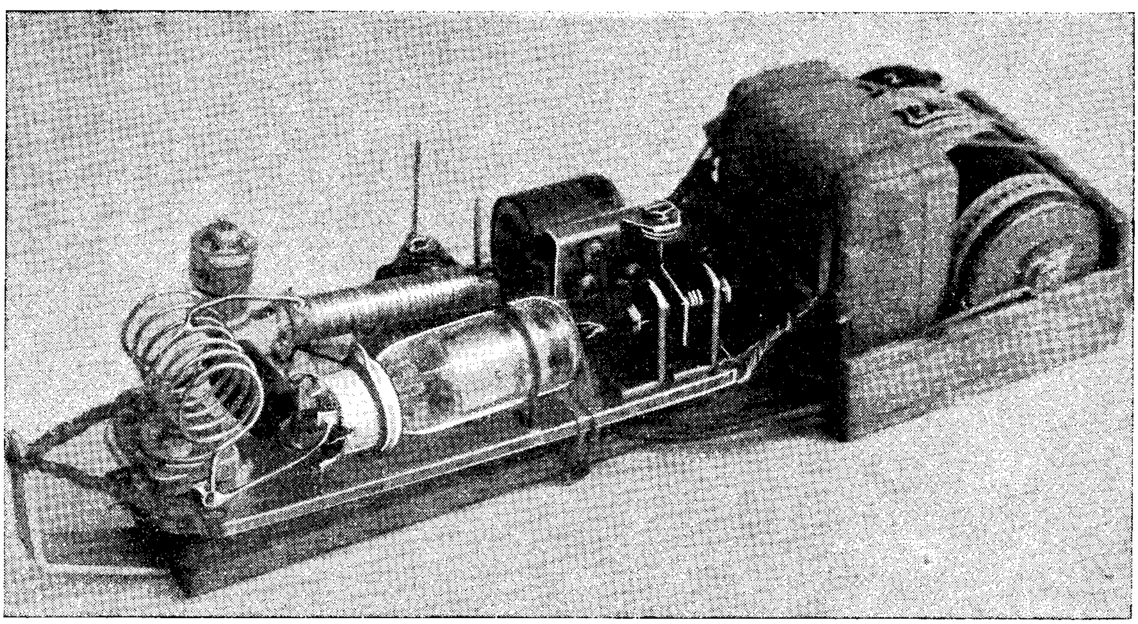
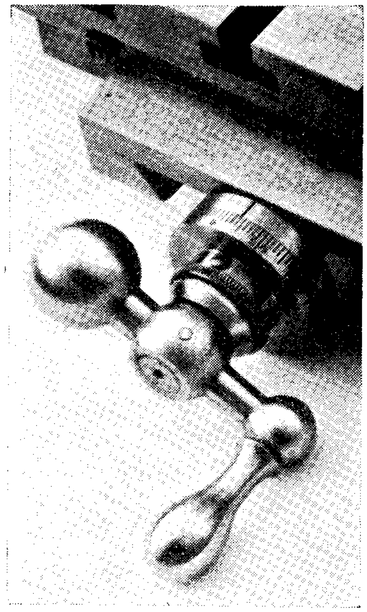


Fig. 16. *Simple receiver used with the control gear described*

A COMPOUND SLIDE-REST FOR THE DRILL PRESS



Close-up of handle and index sleeve, showing graduations

By A. E. Kerswell

HOW does anyone get an inspiration to construct something, and what keeps the flame burning brightly until the job is completed? This is how mine happened. October, 1951, was the month of our model exhibition in Bristol and I was busily engaged with other members, in going around and collecting the models from the various members' homes.

At 9.30 p.m. we arrived back at the exhibition hall and upon entering I noticed a member busy drilling holes with a drill press (bench type) that had a compound slide instead of the usual table. Upon this could be fixed a vice, or an auxiliary drill table, and as it had a fine adjustment feed attached to the quill, the machine was, in effect, a light vertical miller-cum-driller.

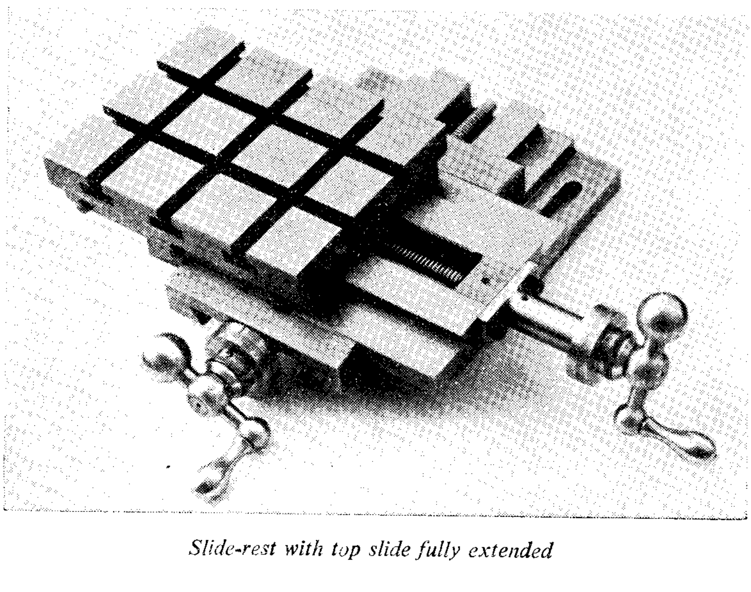
A Useful Accessory

There it was staring me in the face, and what a useful accessory for my workshop. From that moment, for me, the flame was alight. Ah, but how about the raw materials for the job? Our friend of the drill press had made his from the solid or fabricated parts from steel plate obtained at his place of work. I was not in that fortunate position but, the quest was on.

I went sniffing around the old-iron yards in my spare time and after a week or so, I had succeeded in obtaining a length of steel bar $2\frac{1}{2}$ in. dia., which turned out to be stainless (how lucky!) and I picked up a solid block of cast-iron $7\frac{1}{2}$ in. × $7\frac{1}{2}$ in., by 4 in. thick machined up both sides, that had been broken off a large column.

As I had access to an excellent 8-in. shaper, I was not worrying about removing a lot of surplus metal, but I had to split this block of metal in halves, to make two pieces $7\frac{1}{2}$ in. × $7\frac{1}{2}$ in. × $1\frac{3}{4}$ in. for top and bottom slides. This was accomplished on my drill press by drilling a line of $\frac{5}{16}$ in. holes each side of the block, meeting in the middle, and splitting the block apart with fox wedges.

As I feared, the centre when split, was found to be a little spongy, but as a lot of machining was necessary, practically all this was removed and both base and the middle slide were completed. My final piece of luck came when one of our members wanted to dispose of a cast-iron block that had tee-slots machined in it. This, when cut down in size and the vee's machined, became my table. The main idea was to keep the height of the slide-rest down to the minimum and to ensure rigidity with wide slides.



Slide-rest with top slide fully extended

Materials

After machining all the vee's and doing all the necessary shaping, these parts were put aside for a few weeks, whilst my spare time was used making the other parts. Screws, $\frac{1}{2}$ in. dia., ten square threads per inch, left-hand, were required and a tap was first made from a piece of car-axle steel. I have found this excellent material for taps or cutters, and hardens quite well dipped in water, no tempering being required. It cannot be softened, however, for any re-machining after once being hardened.

Brass nuts were made and fixed to the respective slides by cap-screws and dowels, the drilling and tapping for the square thread being left until the assembly. The $2\frac{1}{2}$ in. bar of stainless-steel was then machined for the extension bearings, the index sleeves, and the ball-handles. A plate gauge was made, using one of

the ball-handles of the shaper for a guide, so as to enable me to make both alike.

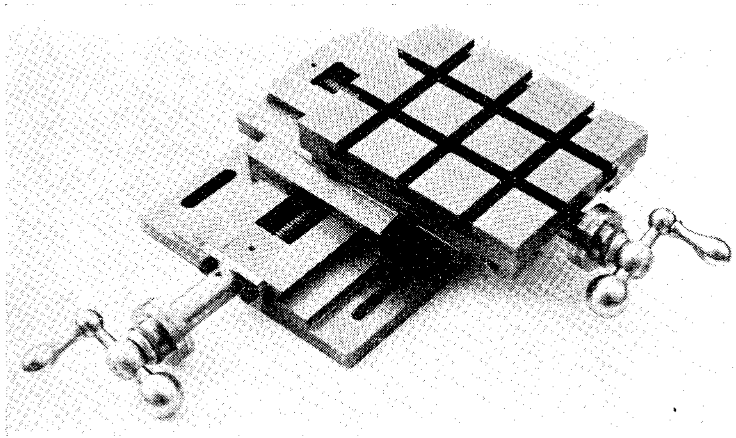
The 2½-in. bar had to be reduced to 1¼ in. and under for the handles, but this was only a question of time on a power lathe, although it seemed such a waste of good material. The index sleeves were fitted to a stub mandrel held in the chuck and graduated by using a hundred-tooth wheel on the mandrel of the lathe, with a suitable plunger engaging in the teeth, and the scribing tool held horizontally in the toolpost. Every tenth line was made longer, and in accordance with usual practice, and the sleeve was indexed in under one hour, so nicely indeed, that I re-indexed the sleeves on my Atlas lathe, afterwards, to make them more prominent.

When I came to assemble the slides, I found to my dismay, they had warped some few thou., and were hollow. This meant a lot of work truing up by hand filing and scraping, and I realise now that I should have roughed them out first and then let them settle before finally machining them to size.

However, they went together eventually, and when assembled with the blank nuts in position, they were up-ended in the drill press, bolted to a large angle-plate, and the nuts were drilled using the extension bearings as a guide for the ½ in. drill to spot the nut, and then drilling tapping size with a smaller drill.

The tap was then inserted in the bearing and the nut tapped out in perfect alignment. The tap, by the way, was about 6 in. in length tapered for about 2 in., backed off, stoned up after hardening, and it cut a perfect thread in the brass nuts. As readers can see, this method is far better than trying to cut the nuts in the lathe ; also, new nuts can be made easily if and when required.

Nothing more remains, except to say that the total cost was a few shillings, and what a useful tool was made. With the index sleeves, one could bore holes to a tight limit, in the case of a drill plate for a jig, besides light milling. Needless to mention, before the flame of inspiration finally dies out, the fine adjustment feed to the quill of the drill press will have to be undertaken.



Slide-rest with bottom slide fully extended

COMPONENTS FOR RADIO CONTROL

(*Continued from page* 195)

the control knob is moved, the disc must transmit the correct number of signals corresponding to its final position.

Manual Control

However positive any device may appear, it is always a wise provision to include in the control box a simple button operated pair of contacts or a microswitch. These are wired in parallel with the steering control and enable one to correct any error in one of the components of the system as well as to get into phase at the commencement of a run.

This microswitch can also be used to send engine control pulses—one long and two short—but a more satisfactory arrangement is to provide a separate " engine room telegraph " on the control box. This is a simple rotary switch as shown in Fig. 15. On the inside of the control box is mounted a perspex base supporting a long and two short arcs of thin copper. These are wired together and form one connection. A wiper arm **A** is fitted to the end of the control shaft which terminates in a suitable handle externally. Good contact is made with the wiper arm by a spring leaf **B** (bent to clear **A** except at the centre). This leaf forms the second connection and the unit is wired in parallel with steering control and microswitch. One complete revolution of the control sends the required engine signal and advances the engine selector by one step. A further refinement is to gear down a lettered disc from the control shaft so that the appropriate engine control position appears in a window in the control box.

General

Both the manual and clockwork steering control units are adaptable to other functions, controlling in fact any system using three steps, whether of the escapement type or selector type.

One common simple kind of escapement gear uses four positions—port, neutral, starboard, neutral; by spacing the escape teeth at 120 deg. instead of 90 deg. one can get a port, neutral, starboard sequence and use the manual pulsing unit to control it. The clockwork unit can, of course, be fitted with more than three positions.

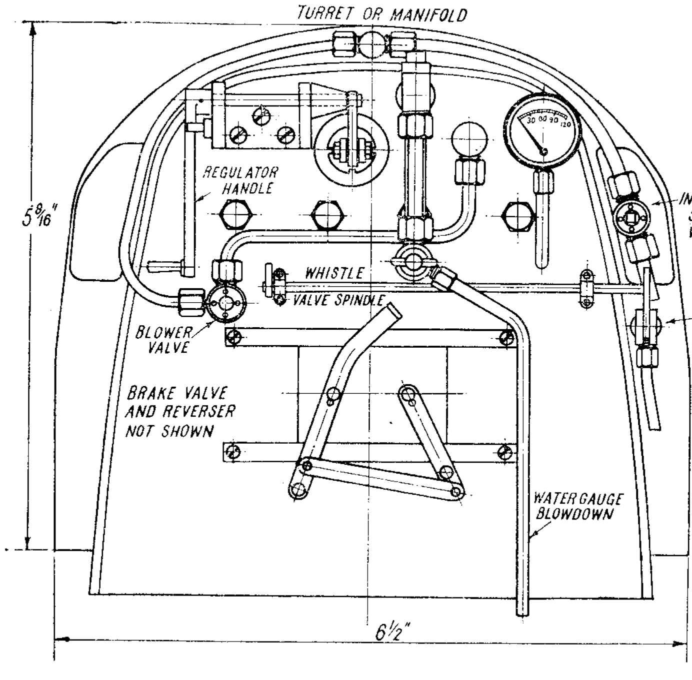
It will be seen that by the use of devices such as those described, the relatively simple sequential systems can overcome the snags commonly associated with them, and it will be found that they often do quite as much as superficially more attractive schemes can perform. One advantage gained is the use of a minimum quantity of electricity for both transmitter and model since no continuous transmission of pulses is ever necessary.

Finally, though immaterial to the apparatus described, Fig. 16 is a photograph which may interest readers. It shows a simple radio unit (self contained except for aerial) used commonly in conjunction with the controlling gear in Fig. 12.

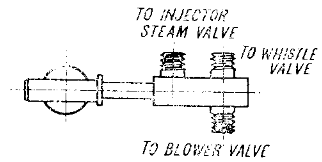
L.B.S.C.'s "Britannia" in 3½ in. Gauge

● **BACKHEAD FITTINGS**

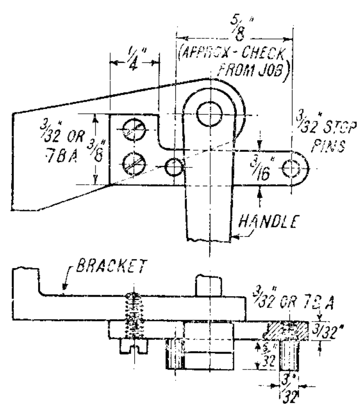
OPEN confession, says the old saw, is good for the soul; so I'll confess right here, that the job of setting out the arrangement of the backhead fittings for the little *Britannia*, has not only given me the proverbial "pain in the neck," but extended my train of impolite expressions well on towards Carlisle. In the ordinary course of events, it is not the least trouble to set out a was to grab the bull's horns before he got frisky, and the result you see in the accompanying illustration. Although the layout isn't *exactly* the same as big sister's—it *couldn't* be, in any case, as I'll explain in a minute, for the benefit of the uninitiated—it bears a distinct family likeness to what the enginemen see in their full-sized cab. There is the big regulator handle hanging from a manifold or turret on top of the firebox wrapper. This is similar to full-size practice, but the manifold is a simplified edition, having no screwdown valve, which not only isn't needed on a 3½-in. gauge engine, but there isn't room for a suitably-sized one. The pipes are also inside the cab, both for ease of construction and convenience in connecting up.



Arrangement of footplate fittings (slide-valve regulator)



Plan of turret



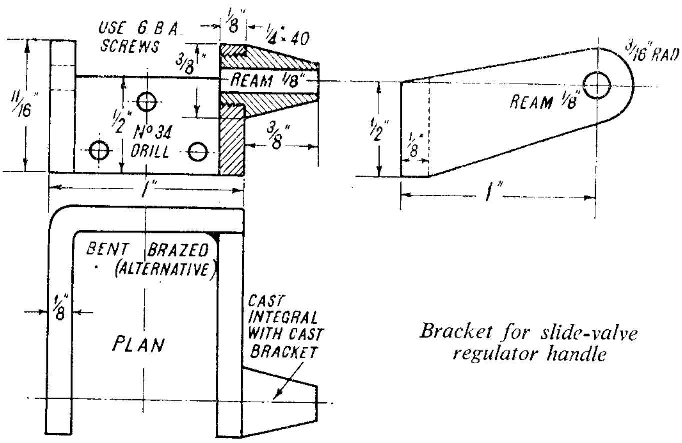
Slide-valve regulator stops

boiler backhead with a neat arrangement of small but quite serviceable fittings, as used on my own engines, and passed O.K. by more than one "full-sized" C.M.E.; but if I did just that, in the present instance, the result would be that I should promptly receive 1,084,372 indignant letters (I worked that out with a slide-rule, so it *must* be correct!) pointing out that the arrangement shown, wasn't a bit like that on the full-sized engines, and what was I going to do about it?

The obvious thing to do, naturally, down on the left-hand side; the blower valve right close handy to it; one water gauge, and the steam gauge, in approximately "full-size" positions; the injector steam valve on the right, but a little higher than correct position, simply for the purpose of rendering it more get-at-able to a driver riding on a car behind the tender; the operating gadget for the whistle, stretched right across the backhead, with a handle at each end; and the sliding firehole door. Steam to the blower, injector, and whistle-valves, is taken

Nature will *NOT* be "Scaled"

If anybody—and in saying that, I don't care a brass button who it is—asserts that he can make "scale" footplate fittings for a boiler backhead on a 3½-in. gauge, or even a 5-in. gauge engine, that will work satisfactorily, he is merely endeavouring to assert his superiority, and belittle the efforts of others. *It can't be done*, and I'll tell you why. "Scale" fittings *can* be made (I have made them) but they would be merely useless ornaments; when Carson's made a "scale" backhead



Bracket for slide-valve regulator handle

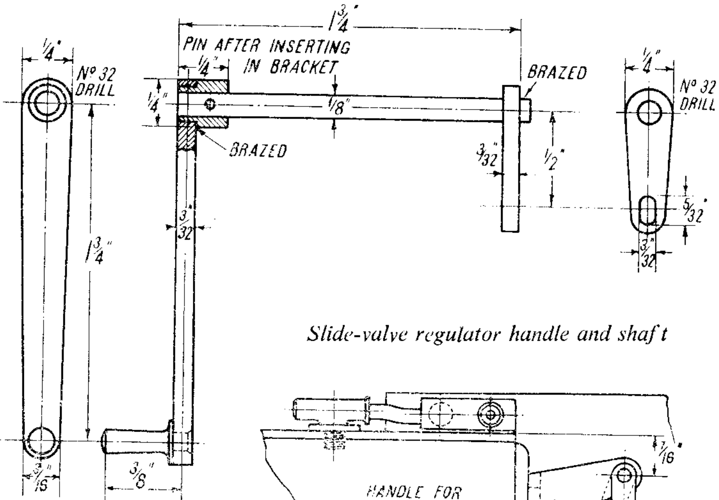
for their super-detail *Great Bear*, it was a dummy, which was removed when it was desired to run the engine under steam. Now I have here beside me, at the present minute, a full-size locomotive water-gauge glass, of standard size. It is $10\frac{3}{4}$ in. long, a bare $\frac{5}{8}$ in. outside diameter, and has a $\frac{3}{8}$ in. hole through it. A "scale" glass for a 5-in. gauge engine would be 10/113ths of this size; or let's be generous and call it 1/11th. The bore of the glass would thus be 1/11th of $\frac{3}{8}$ in. which, in the days when I went to school, would be 3/88 in., or a shade over 1/32 in.; and the thickness of the wall would be—as the outside diameter is less than $\frac{5}{8}$ in.—approximately 1/96 in. thick! How anybody in his right senses could ever assert that a glass tube of the given sizes could indicate the correct water-level in a 5-in. gauge locomotive boiler, is something that gets me guessing; and even if the effect of capillary attraction could be overcome (it can't; a glass with a bore of $\frac{1}{8}$ in. indicates a higher level than the water in the boiler) how much steam pressure would a glass tube 1/96 in. thick stand?

It is just the same with the rest of the fittings. The holes through cocks and valves would not pass sufficient steam and water, and they couldn't be enlarged without making the outside bigger. On my L.B. & S.C.R. single-wheeler *Grosvenor*, I made a "scale" coal-watering cock, just for the sake of sentimentality. We had no hoses; just used to fill the pail from the cock, and throw the water over the coal. The water in the Stroudley tenders always got hot, as part of the exhaust steam went back into the tender (one reason for the very low coal consumption) so Curly always used to have a good wash in the pail before going home. I could never bear being seen in public with a face like a nigger-minstrel; and a bit of soap, a small towel, and a comb, took up very little room in my tommy-bag. Naturally, I came in for plenty of good-natured banter; cleaner boys would offer me face-cream and powder in the shape of tallow and soot, but it was all good honest fun. Well, as I was saying, I made and fitted the weeny water-cock, just under the coal slide, and it works; but as the hole through the plug is only a No. 70 drill-hole, the water comes out in drops, and it would take a dickens of a time to fill a "scale" pail!

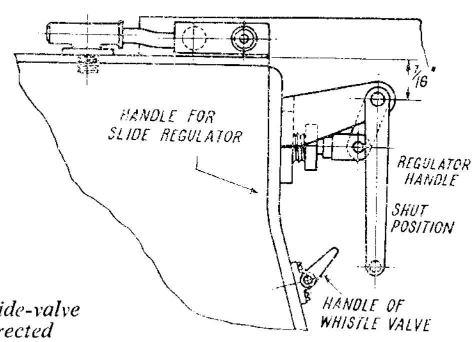
Having personally built many more locomotives than anyone else who has ever written articles in this journal, *and without assistance from any person or firm*, I have found that the best and most reliable boiler fittings and mountings are those which look like the full-sized articles, are large enough to be efficient, yet at the same time not large enough to be clumsy, like the commercial fittings still advertised in some firm's catalogues. It is hardly necessary to add that my designs of fittings have been marketed commercially, both with and without acknowledgments; but I'm not worrying about the latter, as the personal appearance of the goods betrays their origin. Well, so much for that; now let's get busy and adorn *Britannia's* backhead.

Handle for the Slide-valve Regulator

The handle for the slide-valve type of regulator is carried by a channel-shaped bracket screwed to the boiler backhead, and is shown in the general layout, also as a "side-show." The bracket may be built-up or bent, or cast, or it may be cut from a piece of channel steel. The built-up bracket needs two pieces of $\frac{1}{8}$ in. steel plate, cut to the



Slide-valve regulator handle and shaft

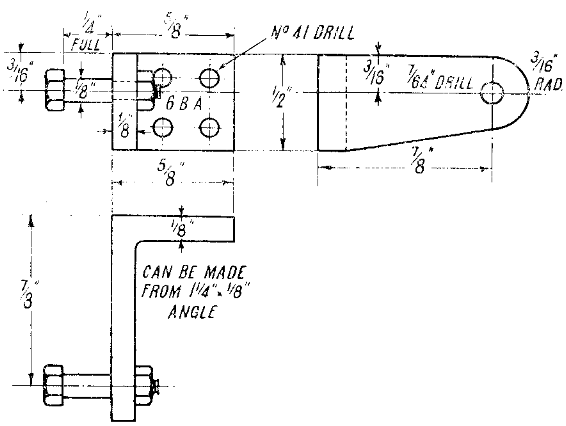


Right—Side view of slide-valve regulator handles erected

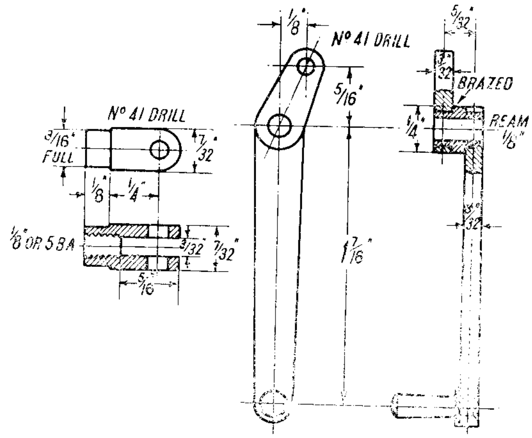
shape and dimensions shown in the side view in the detail illustration ; these are brazed to a piece of $\frac{1}{2}$ in. × $\frac{1}{8}$ in. steel, 1 in. long, forming a channel. A bent bracket can be made by bending a piece of $\frac{1}{8}$ in. steel, $\frac{11}{16}$ in. wide, into a channel shape, and sawing and filing the sides to the given shape and size. If ready-made channel steel is available, a piece of $1\frac{1}{4}$ in. × 1 in. × $\frac{1}{8}$ in., $\frac{3}{4}$ in. long, will be just right to saw and file to the given dimensions.

Mark off and drill a No. 34 hole on each side of the bracket, as shown ; take great care to have end, and countersink it ; the hole at the wider end is drilled $\frac{3}{16}$ in., and a stepped bush, turned from $\frac{1}{4}$ in. round mild-steel, and drilled No. 32, is pressed into the hole, and brazed or silver-soldered. After cleaning up, turn up a little tapered grip from $\frac{3}{16}$-in. round mild-steel, leaving a 3/32-in. pip on the end, about $\frac{1}{8}$ in. long. This is squeezed into the hole in the narrower end of the handle, and riveted over into the countersink ; file flush.

The spindle is a piece of $\frac{1}{8}$ in. round steel $1\frac{13}{16}$ in. long. The drop-arm, or pendulum lever, at the pin in the fork is at the bottom of the slot. Scratch a little circle on the backhead, with a scriber, through one of the screw-holes in the bracket ; remove bracket, centre-pop the circle, drill No. 44, tap 6 B.A., replace bracket, and fix with a 6-B.A. brass screw. Drill and tap the other two screw-holes in the backhead, through the holes in the bracket, and you'll be certain to have them in line. Hexagon-headed screws can, of course, be used if desired, but don't forget to put a smear of plumber's jointing on the threads. Tip : after sundry experi-



Bracket for poppet-valve regulator



Handle for poppet-valve regulator

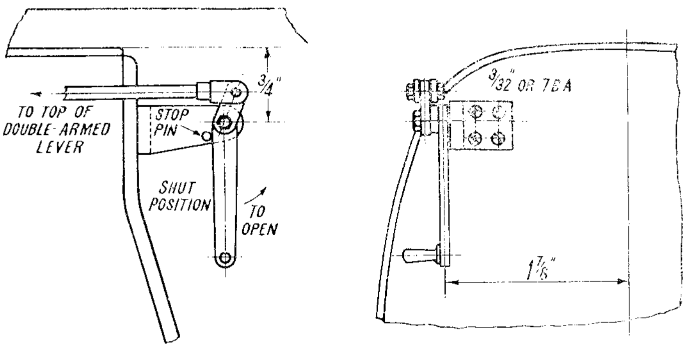
both holes in line. Ream one of them with a $\frac{1}{8}$-in. parallel reamer (the left, when looking at the bracket with the open side toward you). Open out the other side with a 7/32-in. drill, and tap $\frac{1}{4}$ in. × 40. In this is screwed a bearing made from bronze or gunmetal, looking for all the world like a taper buffer-socket ; and you don't need any detailed instructions to make a simple thing like that ! Drill the hole No. 34 first, and poke the $\frac{1}{8}$-in. reamer through the hole in the other side of the bracket, into the bearing, when you ream it. This will ensure both holes being in line. Drill the three screw-holes as shown, and you're all set.

A cast bracket will have the bearing cast integral with it. All it needs in the way of " machining," is a clean-up with a file, and the holes drilled and reamed. Mark off and drill each side separately, and ream both together ; drill screw-holes as above.

The driver's handle is made from a piece of $\frac{1}{4}$ in. × 3/32 in. mild-steel strip, filed to shape shown. Drill a 3/32-in. hole at the narrower opposite end to the driver's handle, is filed up from $\frac{1}{4}$ in. × 3/32 in. steel, the upper end being drilled No. 32, and the lower end drilled 3/32 in. and slotted as shown. Press the drop-arm on to the end of the spindle for a distance of $\frac{1}{16}$ in., and braze the joint where the spindle comes through. Poke the spindle through the bracket from the long bearing end, and press the driver's handle on to the other end, setting handle and arm at the angle shown in the side view of the whole doings erected ; but don't pin the boss to the spindle yet.

How to Erect the Assembly

The erection is just a matter of trial-and-error. Take off the dome cover, and make sure the steam port in the regulator block is completely closed, when the rod, with the fork at the end of it, is pushed home. Now put the handle-and-bracket assembly temporarily in position, with the drop-arm in the slot in the fork on the end of the regulator rod, and put a piece of 3/32-in. wire through fork and arm. Adjust height of bracket, so that the temporary ences with " brass " screws rotting away, the brass being commercial screw-rod with too much zinc in it for boiler work, I make my own boiler screws from phosphor-bronze ; and as hexagon drawn phosphor-bronze is a commercial article obtainable in all sizes from $\frac{1}{16}$ in. upwards, you can easily make dinky hexagon-head screws from stock rod only a weeny bit larger than the screws themselves, leaving delightful little heads. However, be mighty careful to avoid spoiling their pristine beauty when tightening up ; the best way is to use a home-made box-spanner. The late Mr. D. M. Picknell, of " Baernegum," whose *Princess Marina* was one of the finest jobs ever seen, once sent me some box spanners, the business ends of which were just Allen grub screws. The conical ends were drilled up to take a brazed-in stem with a cross handle, and the screw threads were turned off, the hexagon holes in the ends of the screws being an exact fit on the corresponding hexagon heads of the ordinary screws which the spanners were intended to operate. Jolly good wheeze, that !



Handle in position for poppet-valve regulator

After fixing the bracket, see that the regulator valve in the dome is still completely closed, then adjust the driver's handle on the spindle to hang vertically down. Drill a No. 53 hole through boss and spindle and squeeze in a pin made from $\frac{1}{16}$-in. steel wire. Replace the temporary pin in the fork by a bolt made from 3/32-in. silver-steel, nutted at each end.

Regulator Stops

File up an L-shaped bracket from a piece of 3/32-in. steel, as shown in the detail illustration, and attach it to the outer side of the regulator-handle bracket by two 3/32-in. or 7-B.A. screws as shown. The longer arm of the bracket, passes between the regulator handle and the main bracket. A peg, made from a scrap of 3/32-in. silver-steel is screwed into this as shown, touching the side of the driver's handle in the vertical position, thus forming the " off " stop.

Now slowly pull the regulator handle outwards, and watch the port open in the valve in the dome. When it is just fully open, leave the driver's handle in that position, and fit another peg in the L-bracket, just touching the outer side of the handle. Round off the end of the L-bracket, and there's another good job done. Unless you're a bad fireman, and let the steam pressure drop, you'll never have to pull the handle right back against the stop, with the heaviest load in normal service, given average workmanship on the cylinders and motion !

Handle for Poppet-valve Regulator

This pans out a little simpler than the one described above, as the actual connection to the spindle of the poppet-valve regulator in the smokebox isn't made until the boiler is erected on the frames. The bracket, in this case, is angle-shaped, and can be made from a piece of $1\frac{1}{4}$ in. × $\frac{1}{8}$ in. commercial angle, or bent up from $\frac{1}{2}$ in. × $\frac{1}{8}$ in. mild-steel, or may be cast. The shape and size can be seen in the drawing. Instead of the handle being mounted on a spindle, it works on a pin, the hole for this being drilled at $\frac{7}{8}$ in. from the bolting face of the bracket, and $\frac{3}{16}$ in. from the top. Use 7/64-in. drill. The pin can be turned from $\frac{3}{16}$-in. or $\frac{1}{4}$-in. hexagon steel rod, or it may be made from $\frac{1}{8}$-in. silver-steel, which is better for resisting wear. If the latter is used, turn down one end of a $\frac{5}{8}$-in. length to 7/64 in. diameter, screw 6-B.A. and fit a nut. The other end is turned down likewise, to a tight fit in the hole in the bracket, leaving a full $\frac{1}{4}$ in. between the shoulders ; screw the end 6-B.A.

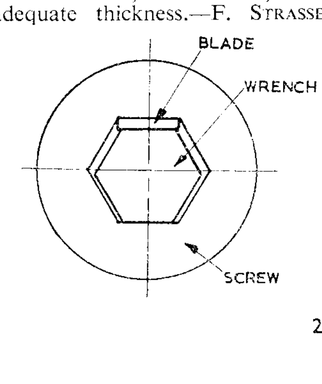
The handle is filed up from $\frac{1}{4}$ in. × 3/32 in. steel, same as described above, and fitted with a similar hand grip, riveted in. The little arm at the top, is filed up from similar material, the hole in the smaller end being drilled No. 41. The holes in the larger ends of both the little arm and the handle, are drilled $\frac{3}{16}$ in. Chuck a piece of $\frac{1}{4}$ in. round mild-steel in three-jaw, face the end, centre, and drill No. 34 for about $\frac{3}{16}$ in. depth. Turn down 3/32 in. of the end to $\frac{3}{16}$ in. diameter, a tight fit in the hole in the regulator handle. Part off at $\frac{1}{4}$ in. from the end, reverse in chuck, and turn down 3/32 in. of the other end, to fit in the hole in the little arm. Squeeze the handle on one end, and the little arm on the other, and make sure the grip is on the same side as the little arm—mistakes are made far easier than most folk imagine ! Set the little arm backwards, in relation to the handle, as shown in the detail illustration, then braze the joint. After all the weeny brazing jobs in the chassis work, I guess most builders will be dab hands at the game ; I call this " jewellery work." The little self-blowing gas blowpipe, made in a few minutes from a bit of $\frac{3}{8}$-in. boiler tube, described some time ago, does all these jobs in two wags of a dog's tail.

After cleaning up, poke a $\frac{1}{8}$-in. parallel reamer through the hole in the boss. Drill the four No. 41 screw-holes in the bracket, put the fulcrum pin through the handle, and attach it to the bracket by a nut as shown ; the handle should work easily, without slackness. Attach the bracket to the boiler backhead, in the position shown in the illustrations, with the fulcrum pin $\frac{3}{4}$ in. below the top of the wrapper and the centre of the handle $1\frac{7}{8}$ in. from the vertical centre-line of backhead. " Mike " measurements are not needed ; in this case, " near enough " will do very well. The fork is shown in the detail illustration and needs no description ; it is made from 7/32-in. square steel, the pin being 3/32-in. steel, nutted at both ends. An " off " stop pin only is needed ; a stub of 3/32-in. steel screwed into the bracket, as shown, will fill the bill nicely. Next stage, gauges and valves.

SOCKET SET-SCREWS TIP

These screws are driven by means of hexagonal wrenches. Sometimes when you have not at hand the correct size of hexagonal wrench, you can take the next smaller size, and putting an appropriate piece of flat material (preferably hardened steel), you can drive the screw without difficulty.

So, in the case of a $\frac{3}{8}$-in. screw, the socket width is 0.1895 in. If you do not possess the corresponding wrench, you take that corresponding to the $\frac{5}{16}$ in. screw, with a socket width of 0.1582 in. and fill the space (0.0313 in.) with a piece of power hacksaw-blade, which has just the adequate thickness.—F. STRASSER.



READERS' LETTERS

● Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

A BUILDER'S CORRECTIONS

DEAR SIR,—I feel I must take this opportunity of writing to you in respect of the description meted out to my 2-in. scale showman's road locomotive-cum-traction engine.

I should like to point out that my engine is *not* chain-driven in any way; it is a four-shaft engine having two speeds with full differential; and that the cleats or strakes do not come to the edge of the wheels, as they are shod with tyres of compound rubber on all four wheels. As this engine is a free-lance and built for passenger hauling, it may be a bit out of scale in some respects. The steering wheel is correct size but the handle is oversize to enable it to be gripped when at work; also, the reversing lever catch is oversize, as a scale one would soon be useless. At the same time, it is not so unsightly as some I saw at the exhibition, which would require a driver about 8 ft. tall to operate them in comfort. The steering chains also were commented on; I think they are to scale being made from $\frac{1}{8}$ in. steel rod which is equivalent to $\frac{3}{4}$ in. dia. full size.

I *did* make all of the engine, including all gears, also painting and lining. The hind wheels were made in the orthodox way, from T-section steel turned round a special jig which I made for the job. This engine has several original ideas in it which I obtained from experience gained by working on the real things. I have had the pleasure of seeing and driving a number of new traction engines which the firm where I was apprenticed used to supply to farmers. My firm had a $9\frac{1}{2}$-ton Garrett compound, one year old when I started working for them; I now have all the brass nameplates, whistles, etc. Much to my regret, she has gone to the melting pot.

Yours faithfully,
Worthing. R. W. PERKIS.

THERMOMETER SCALES

DEAR SIR,—I was interested in the article on the above subject in your issue of December 25th, and would point out that there is an easier way of converting Farenheit and Centigrade scales than by using the formulae 9/5 C.° + 32 or 5/9 F.° − 32 respectively.

For $9/5 = 1.8 = (2.0 - 0.2)$.

Therefore, if C.° is multiplied by factor 2 and the result moved one place backwards and subtracted, the final result is the same as multiplying by 1.8.

Thus, $100\ C.^\circ \times 2 = 200$
$100\ C.^\circ \times 0.2 = 20$
$200 - 20 = 180$ add 32
$= 212\ F.^\circ$

This can be done *in the head.*

To multiply by 0.5 is the same thing as to divide by 2.

Therefore, to convert Fahrenheit to Centigrade

$5/9\ (F - 32) = 0.55\ (F - 32)$.

Note. 5/9 is a recurring decimal.

To convert 212 F.° to Centigrade

$$= (212 - 32) = \frac{180}{2} = 90$$

and moving 90 one place back, to account for 0.05.

Total $= 90 + 9 = 99$.

As 0.55 is a recurring decimal add 1 per cent.

$99 + 1 = 100\ C.^\circ$

and so on.

The Reamur scale is seldom or never used.

As the coefficient is always 2, it is easy to work the figures in the head.

Yours faithfully,
Chaldon. W. F. KEARSLEY.

A PARTING TOOL HINT

DEAR SIR,—Parting-off still remains one of the most difficult operations in metal-turning, and many ideas and theories have been expounded as to why such an apparently simple operation should be just the reverse.

Whilst working on a 7 in. lathe for a year or two, I seemed to be having more than my fair share of parting-tool breakages when parting off from the front, whilst breakages when using the back toolpost were few and far between.

The usual explanation given for this state of affairs is that when parting off from the front, the lathe spindle is intermittently forced upwards against the top of the front bearing causing chattering and tool breakages, whereas when parting from the back toolpost, the lathe spindle is held firmly down in the front bearing by the reaction of the cut, so that chattering and breakages are at a minimum.

Whilst this reasoning is quite correct on under-driven lathes with plain spindle bearings, with oil clearance, it was not the cause of the trouble in this case, as my lathe had new dual-purpose ball-bearings on the spindle, and there was negligible lift at the nose end.

Eventually, I found that the source of the trouble was a slight deflection of the top-slide when under pressure, so that the tool heeled over slightly to the left and attempted to take a cut on that side and the front at the same time, usually with fatal results.

The solution then was obvious, and merely amounted to slip-stoning the top left edge to a slightly negative rake, almost up to the front cutting edge, so that if the tool did heel over slightly under pressure, it could not dig in and bring disaster.

Yours faithfully,
Bradford. HERBERT LEE.

SUSSEX PLOUGHING AND ROAD ENGINES

DEAR SIR,—Many thanks for publishing my letter in your January 15th issue. I must, however, point out three misprints which appeared and ask you to publish this note giving the correct words, otherwise I can foresee interested people writing about makes of engines which do *not* exist ! The misprints referred to are as follows :—

Line 37 of the letter : " . . . and Petersfield is a *Farrell*," This should read Fowell.

Line 40 : " . . . a *Barrett* single-cylinder . . . " This should read Garrett.

Line 43 : " . . . by Barretts." This should read Garretts.

Yours faithfully,
Pulborough. G. C. HUDSON.

THE MODEL SAVERY LAUNCH ENGINE

DEAR SIR,—I was very pleased to see the way in which my article on the above engine was presented. The drawings and photograph have come out remarkably well. I would, however, like to point out that two errors have been made in the dimensions of the I.P. cylinder as given on page 44.

The bore of the cylinder, which is stated as $1\frac{5}{16}$ in. should be $1\frac{15}{16}$ in., and the stroke, given as $1\frac{3}{8}$ in., should be $1\frac{5}{8}$ in.

Yours faithfully,
Hollinwood. A. W. G. TUCKER.

Simple method of cutting gears

By L. C. Mason

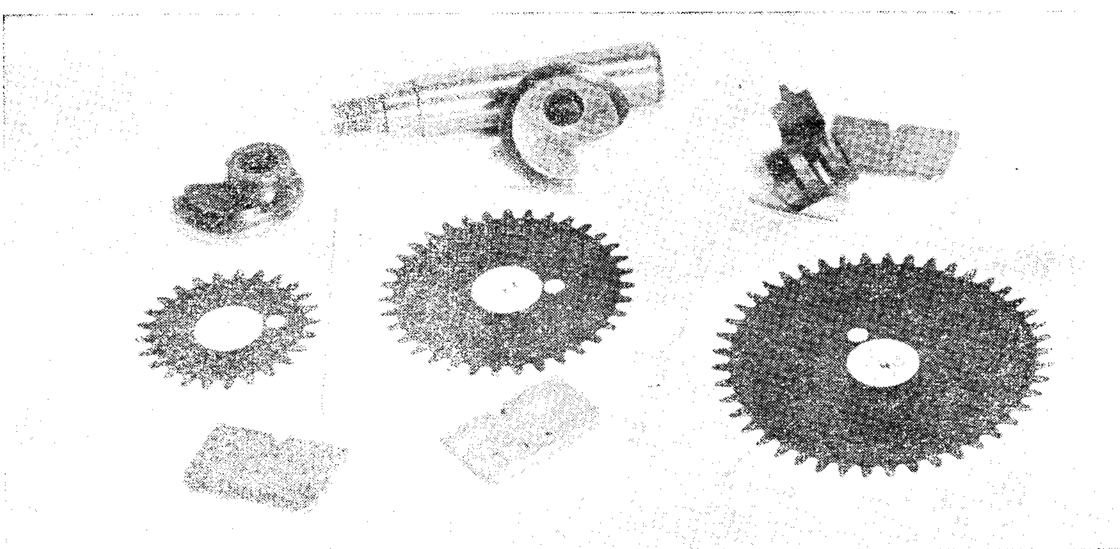
THE major problems in producing small gears are those concerned with shape and dimensions of the teeth, rather than the actual cutting, which is a relatively straightforward process.

Where no cutters at all are available for producing gears of a given pitch, it is not difficult to produce cutters nearly enough correct for all normal purposes using the lathe change wheels as specimens, *no matter what the pitch of the gears required.* To take a concrete example: the writer's lathe change wheels are of 16 pitch, the 40-T. wheel—picking one at random—being 2½ in. pitch diameter. The description of gears in terms of "diametrical pitch" shows the number of teeth on a wheel of 1 in. diameter. In this case of 16-pitch gears 2½ in. (diameter) times 16 (pitch) gives 40 (number of teeth). Similarly, the 30-T. is 1⅞ in. pitch diameter, while one 3⅛ in. diameter would have 50-T., and so on.

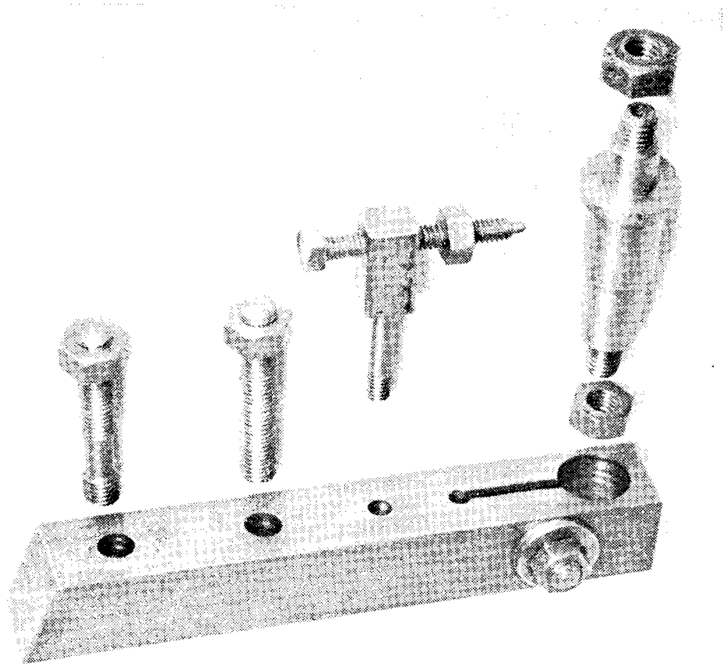
In this case, it was required to produce cutters for a number of gears of 20 pitch, the only available specimen gears being the 16-pitch change wheels. Considering the example of the 40-T. wheel again, this is 2½ in. pitch dia. If, now, this could be "shrunk" proportionately by one-fifth, down to 2 in. pitch diameter, the result would be a correctly proportioned wheel of 2 in. diameter still having 40 teeth—which is clearly 20 pitch. This could be used as a template for making 20-pitch cutters. Obviously, the change wheel itself cannot be played about with like that, but you can diminish or enlarge an extremely accurate replica of it—a photographic image.

The procedure is to photograph a selected wheel so as to obtain a reasonably sized image on the negative. The wheel has to be square to the film or plate, and if the camera lens is exactly over the centre of the wheel, only the top surface is photographed, ensuring that a foreshortened view of the wheel thickness does not interfere with the tooth shape of the negative. Light the wheel strongly from behind, so that the resulting negative shows a "soot and whitewash" silhouette. The actual dimensions of the wheel on the negative do not matter; the proportions will be correct, whatever size it is projected in the enlarger.

The cutters are produced by reference to a print the size of the wheel required, so draw a circle as accurately as possible the *outside* diameter of the new wheel. Knowing the pitch diameter and the number of teeth $D_p \times \dfrac{(N + 2)}{N}$ gives the diameter over the teeth tips, D_p being the diametrical pitch and N the number of teeth. To eliminate as many variables as possible, draw the guide circle on the back of a scrap print, on the same thickness paper as it is proposed to use for the wheel print. Focus the enlarger to give a pin-sharp image just filling the circle, and make a print on the most contrasting (hardest) paper you can obtain. If a number of wheels were photographed to make cutters for a range of different sized wheels, provided the camera was in the same position exactly for all the shots, then the enlarger, once set, will produce the right sized prints automatically from all the negatives. The photography involved is so simple, that if you do not have the equipment yourself, the least technically minded photographer acquaintance could easily oblige.



Group of small photo prints the required gear size, showing the gauges and cutters shaped up to match



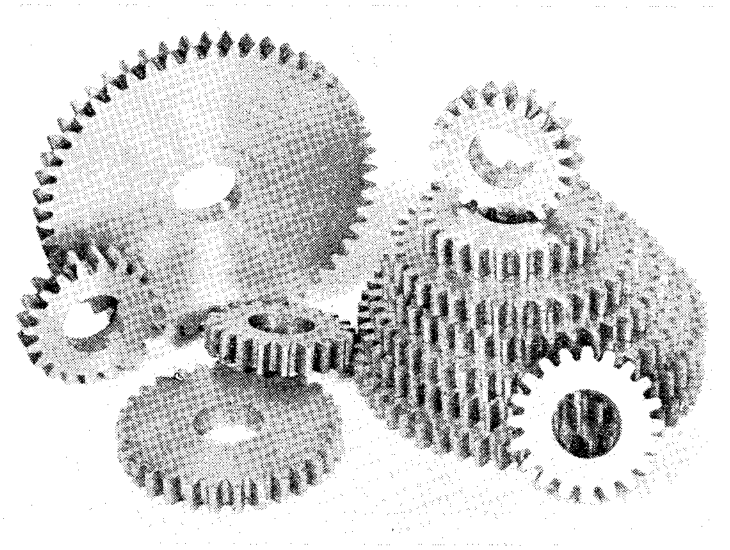
Group of components for the gear-cutting rig

The next stage is a light sheet steel gauge filed up to match any tooth space on the print. A magnifying glass helps here, while the ingenious enlarger owner might be able to project an enlarged image of the gauge in hand on to a very large print of only two or three teeth, using the enlarger as an optical comparator. With a gauge correctly shaped to one tooth space, it is a fairly simple matter to produce a cutter to match it.

The ones shown were turned from slices of 1 in. silver-steel bar. Face the blank both sides, then drill and tap eccentrically for screwing on a stiff arbor for use in the chuck. The arbor is held a similar amount eccentric in the four-jaw chuck, so that the periphery of the blank runs true, and the edge turned to match the gauge. When satisfied with the profile, take a generous triangle out of the blank, leaving the tip of the cutter as the farthest point from the centre of the arbor hole. Leave the corner slightly rounded at the root of the cutting face. It only remains to clean up the cut edges with a file, harden, temper, and stone up sharp. In use, the arbor runs truly, of course, giving the cutter tip a sweep of larger radius than any other part of the cutter. With this shape, repeated sharpenings will not disturb the shape of the cutter profile, and the accessible point of the cutter allows of a light touch-up with a stone during a job, leaving the cutter in position.

Gear cutting rigs are many and varied, the chief requirements being stiffness and ease of operation. The set-up shown on the cover of this issue is about as simple as it is possible to make it, and the main bar being 1 in. square, it is amply rigid. The bar is bolted by two $\frac{3}{8}$ in. bolts to an angle-plate, the bolt farthest away from the chuck being necked down to $\frac{5}{16}$ in. to allow of some slight pivoting in the angle-plate slot for height adjustment. The left-hand end of the bar carries a short stiff mandrel, on the inner end of which is clamped the gear blank, and on the outer end a lathe change wheel for indexing. Each position is located by a pointed bolt engaging in a tooth space on the indexing wheel, the mandrel being locked in each selected position by the clamp-bolt passing through the split end of the square bar. The pointed indexing-bolt is tapped through a small block mounted on the main bar, so that the bolt can just clear the largest wheel likely to be used. The bolt is fitted with a lock-nut, and is long enough to serve as the index for the smallest wheel to be used. When using the largest change wheels for indexing, the index-bolt lock-nut is transferred to the other side of the mounting block. It is not necessary to make the bolt long enough to engage the teeth of the smallest change wheels, as their number of teeth can be indexed by selecting every other tooth on a wheel twice the size. Thus the photograph of a 25-T. wheel being cut shows it

(*Continued on page* 207)



Set of twelve 20-pitch gear wheels, 20 to 50-T., cut from $\frac{1}{4}$-in. mild-steel plate

AN AID TO SCREWCUTTING

By "Base Circle"

THE device shown in Fig. 1 is one which will be found to be extremely useful if screwcutting is indulged in to any considerable extent. We all know how easy it is to make mistakes when screwing in the usual way—that is by taking a cut along the job, withdrawing the tool at the end of the cut, bringing the carriage back to the starting point and then advancing the tool, using the micrometer index on the cross-slide to bring the tool back to the last reading plus the depth of cut for the next traverse. It all sounds very complicated, doesn't it? How often do we find that we have forgotten the last reading? And when we do, it usually takes quite a bit of trial and error before we find the place again. Sometimes we try to get over this difficulty by setting the cross-slide index to zero for each cut, but when we adopt this method it is very easy to lose track of the total depth of thread.

With the gadget shown, which, of course, is similar in principle to those fitted to production machines designed for screwcutting, it is possible to withdraw the tool at the end of the cut without disturbing the setting of the dial in any way.

As designed, the device is suitable for the Drummond $3\frac{1}{2}$-in. lathe, but the dimensions can readily be modified to adapt it to any other machine. It will be seen that the idea is to provide a short auxiliary slide to carry the tool, which allows the tool to be withdrawn from the cut independently of the cross-slide, so that the dial on the latter can be used for feeding the tool to depth and need not be disturbed during the course of the job.

Provision is made for adjusting the height of the tool—it is, of course, very important to have the tool exactly at the correct height when cutting threads—but if this addition is considered unnecessary, it can easily be omitted and provision made for height adjustment in the usual way with the help of packing-pieces. At the same time, tool height is so important, and the additional work involved in making the wedge and fitting it, is so slight that it will probably be found just as well to stick to the design.

A $\frac{1}{2}$ in. hole is shown passing right through the tool holder. This is intended to carry a bar for internal work. If work smaller than this is likely to be undertaken, a bar reduced at the operating end can be made.

The making of the various parts should not present any difficulty, although for the body and the tool slide the use of a shaper will speed up the job considerably. Fig. 2 shows these two parts. The only important point about the body is that the slot to carry the tool slide should be accurate as regards width and depth, with smoothly finished surfaces, so that when the slide is fitted it will move freely but without shake. The slide, too, is a straightforward job. The $\frac{5}{16}$ in. B.S.F. holes for clamping the tool or the bar should have $\frac{5}{16}$ in. square-headed screws fitted. At the rear end a $\frac{1}{2}$ in. Whitworth stud is fitted and pinned in place with a 3/32 in. pin. The 2 B.A. tapped hole is for the wedge adjusting-screw. The $\frac{3}{8}$ in. slot should be accurate as to width so that square section steel tools will be a good fit. Thus, if the tools are accurately ground, a good sym-

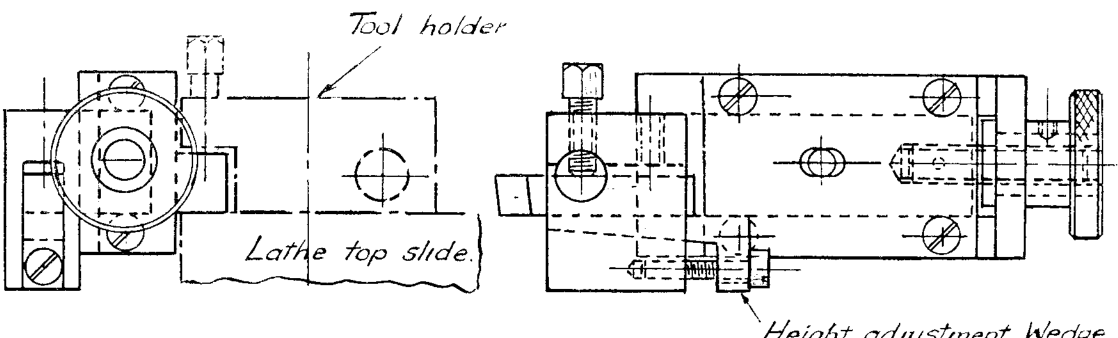
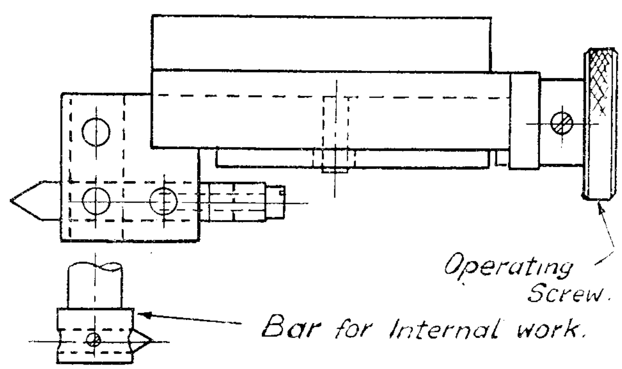


Fig. 1. Screwing tool-holder for internal and external work



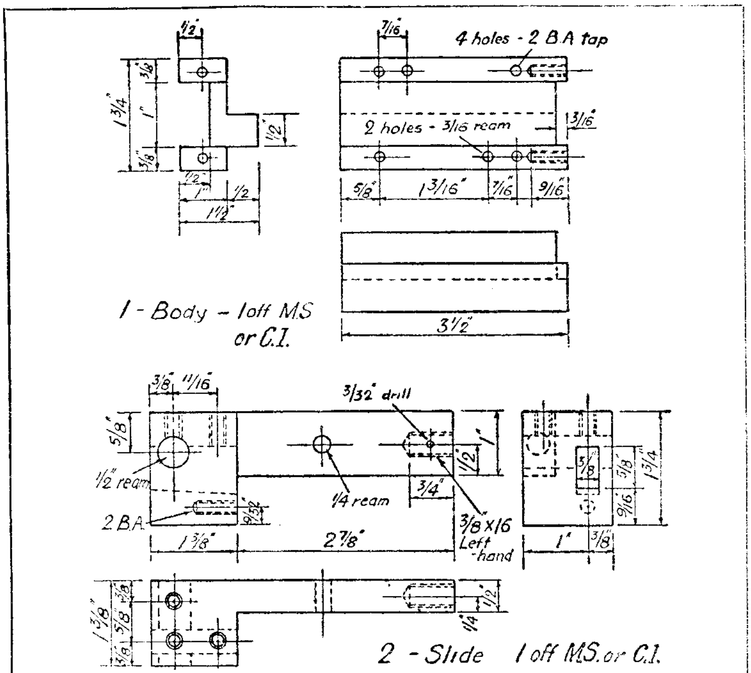


Fig. 2

metrical thread will be produced without any fiddling about.

Fig. 3 shows the smaller details. These are all simple jobs. The slot in the side of the side plate fixes the amount of travel of the slide, and it is thus essential to dowel the plate on to the body carefully—otherwise it would quickly work loose. The knob, detail 5, is fastened to the brass nut, detail 6, by means of a 4 B.A. grub-screw, after assembly with the end plate 4. As regards the bar, detail 9, this should be a good sliding fit in the reamed hole in the tool slide, and the holes for the tools should be square with the bar and should be carefully reamed to size.

An Alternative Arrangement

Fig. 4 shows an alternative arrangement which has certain advantages. It has not been tried but it would appear to be faster in operation. It will be seen that the idea is to operate the slide by means of an eccentric cam which would be mounted in the side plate and would engage in a slot cut across the tool slide. The travel of the slide would, as in the first design, be restricted by a pin in the slide engaging in a slot in the side plate.

It may be as well to point out that whether using screw operation or cam operation, the slide must always be forced up to the end of its travel to ensure that the tool is in its correct cutting position.

One further point—the device, as drawn, is intended to be used with a straight-in feed to the tool—that is, feeding at right-angles to the axis of the lathe. No doubt, however, many readers will prefer to feed the tool at the angle of the thread flank so that the tool is cutting on only one side. The two alternative methods are shown at Fig. 5. Fig. 6 shows the top-slide swivelled round to suit this method with our auxiliary slide mounted on it. It will be apparent that with the Drummond type of tool-holder the clamping-lug on the slide body will have to be extended quite considerably. For other types of lathes, other modifications will no doubt be necessary.

You Takes Your Choice !

It is purely a matter of choice which method is used. Both methods have their advantages and both have their disadvantages. Possibly the reason why the writer prefers the straight-in method is that the Drummond top-slide is not provided with a micrometer index. The fitting of such an index is one of the many jobs which are to be done some day ! Again, there is the other drawback

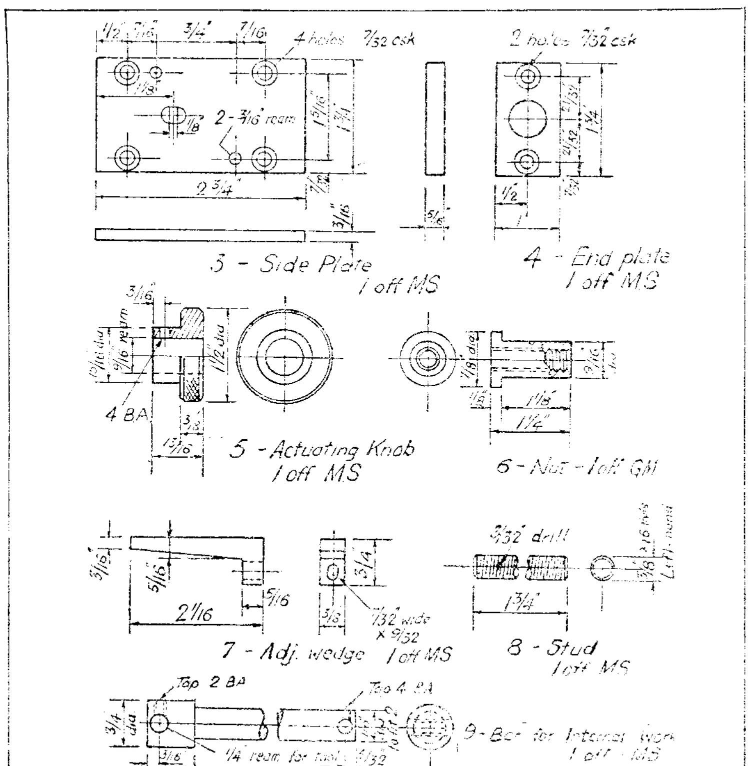


Fig. 3

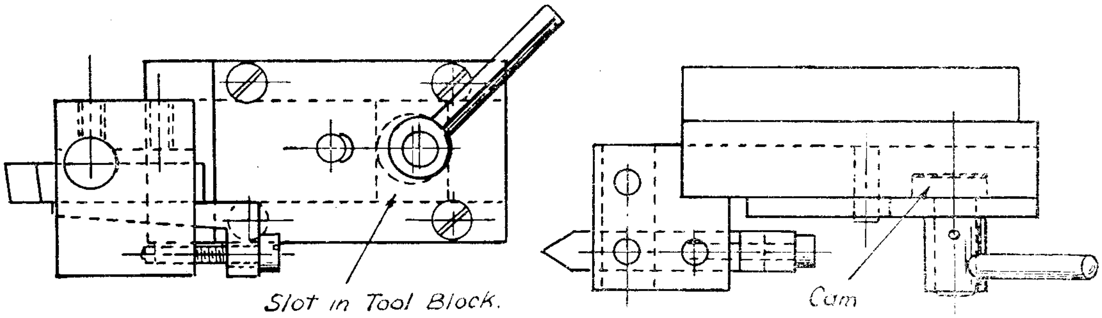
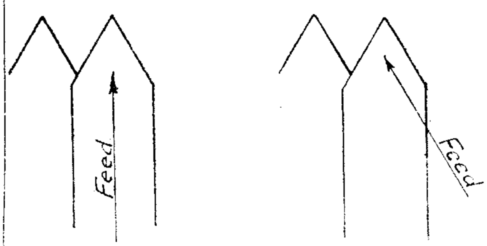
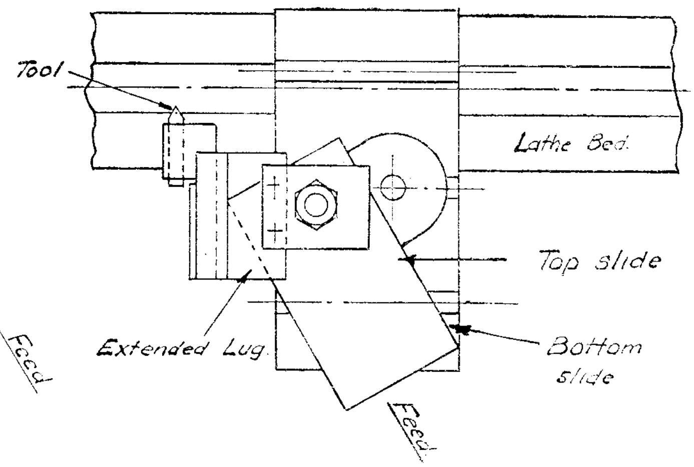


Fig. 4. Elevation and plan of an alternative design for faster operation

Right—Fig 6. Diagram showing tool arranged for feeding at thread flank angle

Below — Fig. 5. Alternative methods of feeding tool into cut





to the angular feed—that one must calculate the depth of thread along the flank.

It may be noted, of course, that using the flank angle method, the auxiliary slide may be dispensed with altogether. All that is necessary is to fit adjustable stops to the cross-slide—the lower slide—so that the top-slide, set at the appropriate thread angle can be used to apply the feed, while the bottom slide is used solely to advance the tool to a fixed stop for cutting and to withdraw it at the end of the cut. Such stops will be found extremely useful for many other purposes—when milling, for example.

Simple Method of Cutting Gears

(Continued from page 204)

being indexed round a 50-T. wheel. This also has the advantage of minimising any possible slight inaccuracies of circular pitch that might be present in the indexing wheel.

The cutters are shaped so that the tooth form runs out into shoulders either side of the cutter. This gives a quick setting-up procedure for any diameter blank without any precision measurements. The whole rig is set up finger tight only, with the square bar lying across the lathe bed. The cross-slide is then fed inwards, passing the gear blank under one shoulder of the cutter at its lowest point. Where it touches will be a tooth tip. The main bar bolts on the angle-plate are then tightened up and the angle-plate remounted at right-angles to its former position, to bring the bar along the line of the lathe bed. Select the first position on the index wheel, clamp up the mandrel lock, and locate for tooth position. There are several ways of doing this, the easiest probably being to find the top point of the gear blank with a scribing block, and locate this in line with the centre of the cutter tip by positioning the saddle with the leadscrew.

The set of steel gears shown—for a miniature screwcutting lathe—were cut with a set of three cutters. Gears as coarse-pitched as this in ¼-in. mild-steel is a rather laborious job with a single-point cutter, but time was of rather less importance than the cost of a set of commercially produced cutters which would probably, at best, be used only very infrequently.

CUTTING CLOCK WHEELS ON A SMALL LATHE

By J. C. Stevens

THE last stage of machining is shown at *C* (Fig. 6). Here the cutter has been removed from the mandrel, the latter turned through 180 deg. and the blank inserted "upside down," as shown.

The blank is turned round as before, a few degrees in a *clockwise* direction this time, and the second side of the cutter machined until it will fit exactly the tooth-space of the sample wheel. The writer found it easy to judge the depth, when machining the second face by closely observing the underneath view where the curved shoulders sweep in close together.

All surfaces should be machined to a good finish and at this stage the cutter is completed, except for the hardening process. The cutting edge was now buried in a small piece of soap and heated to cherry-red over a gas flame and instantly quenched in cold water. The purpose of the soap is to prevent the sharp edges deteriorating under the heat—which it does effectively.

The top flat surface of cutter was now gently rubbed on an oiled Arkansas stone and the front tip very discreetly touched, just sufficiently to brighten the steel, being very careful not to spoil the cutting angle. No tempering is necessary, as there should be scarcely any strain on the tool when in use, the action depending on high speed and slow feed. A good test to show whether the cutter is *really* sharp is to gently apply the edge to the thumb-nail; if it "digs in" all is well.

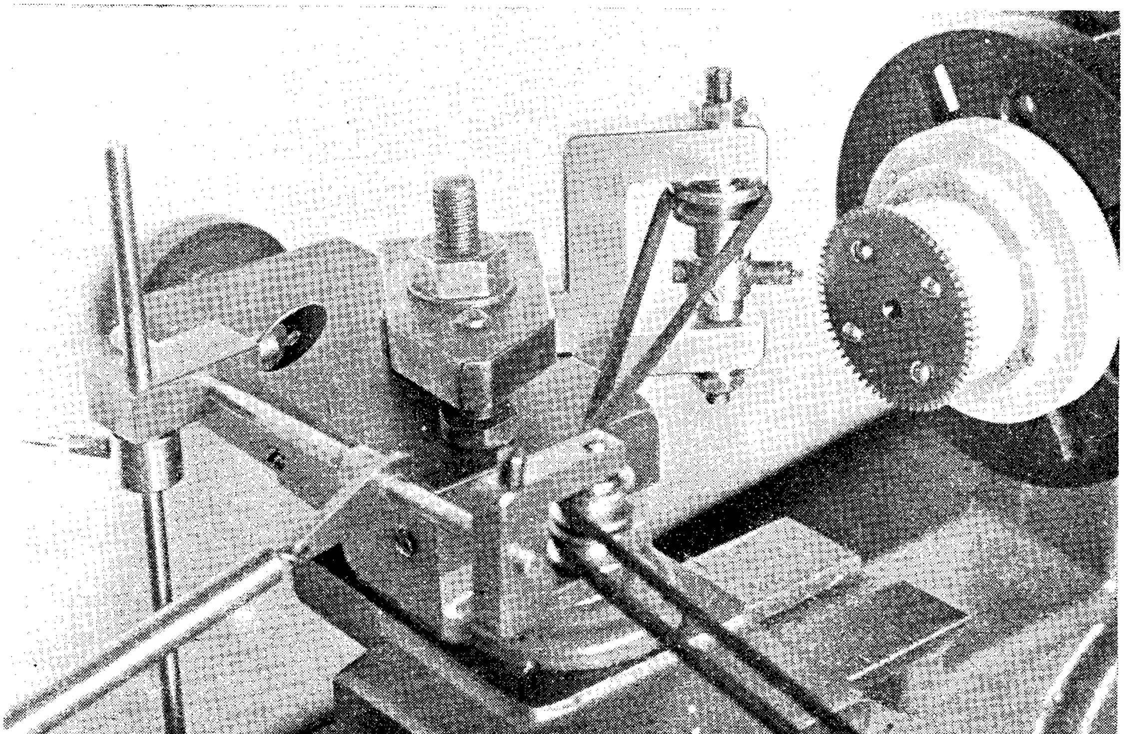
This method is equally successful for making ratchet and crown-wheel cutters, in which cases the tip is machined to the desired angle or curve (in operation *A*), and only the one side machined as at *B*.

Concluded from page 175, *February* 5, 1953.

Using the Attachments

Fig. 7 shows a plan and elevation of the lathe as set up for wheel cutting.

The blank is secured to the wood block by four small screws, this being a convenient method in the case of "crossed-out" (or spoked) wheels, enabling the centre hole to be drilled and bored out truly to ensure concentricity after the teeth are cut. The arms of the wheel are, of course, subsequently worked out between the drilled holes and the waste pieces cut out with a fret-saw and filed to finish.



The fly-cutter and jockey pulleys

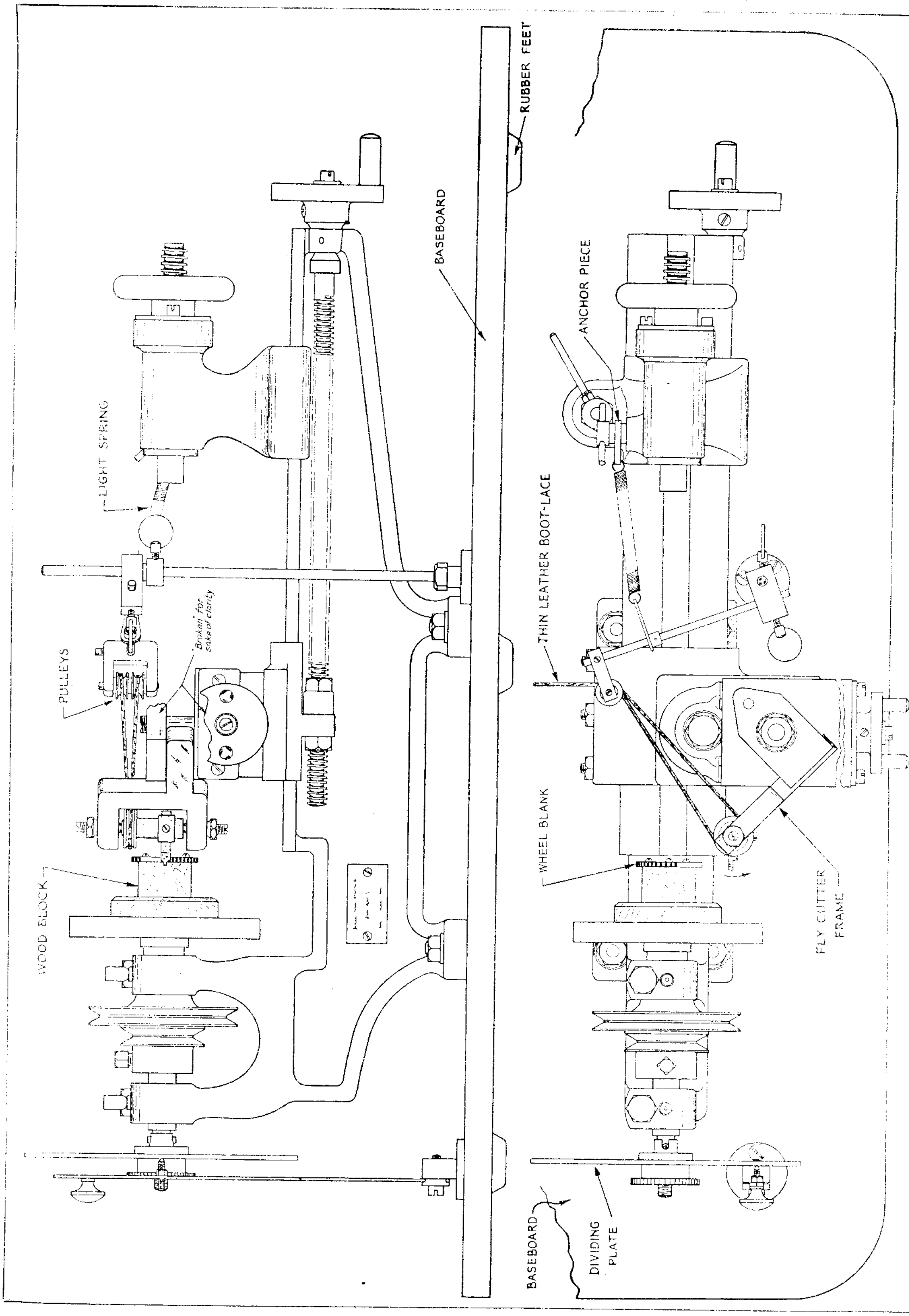
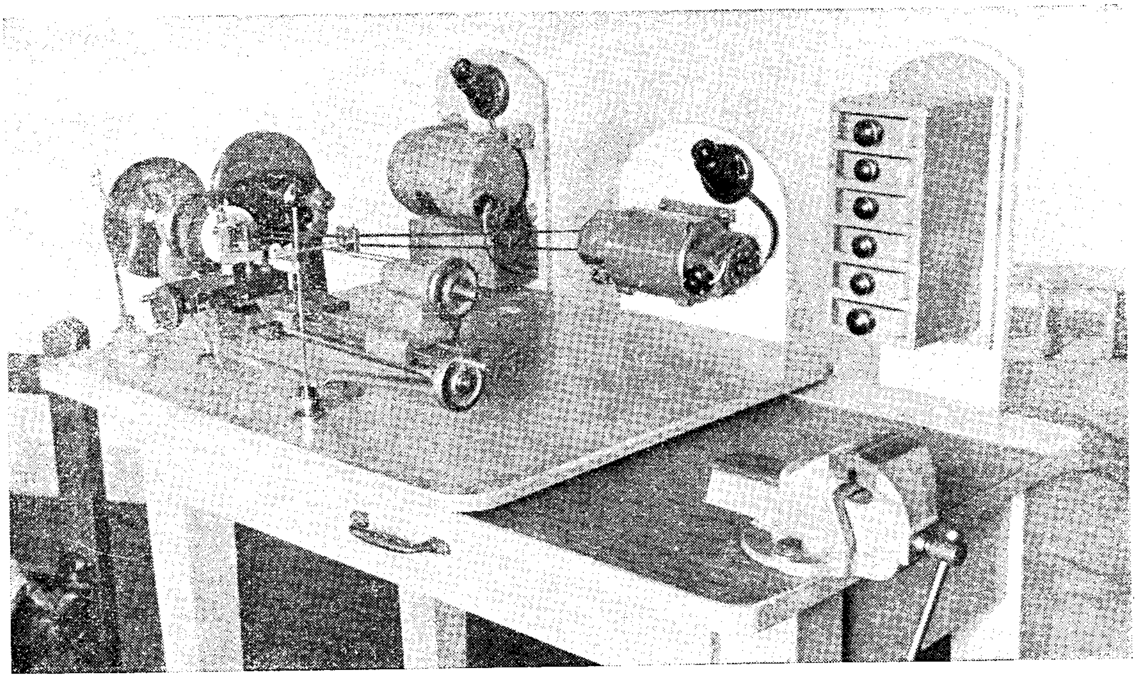


Fig. 7. General arrangement, in elevation and plan, of the lathe as set up for wheel cutting



The lathe and work table

In the case of solid wheels the blank is held by means of a tightly fitting bolt through centre of wood block with a nut and washer at the front end. The bolt should be turned truly in position a close fit in bore of wheel and rethreaded.

The edge of blank is turned down to diameter required and a small "pip" turned at centre to act as a guide when setting the fly-cutter to exact centre height.

With the cutter-frame clamped to cross-slide, rig up the pulleys and make sure the whole assembly runs freely and with a minimum of belt tension. The dividing plate and detent are rigged up to give the appropriate number of divisions, and all is set to cut the wheel.

To set the cutter for depth, take a shallow cut through blank by turning leadscrew slowly and evenly, move plate forward one division and repeat. Cautiously increase depth of both spaces until the tooth so formed has just a tiny flat left at its apex—the smaller this is the better, but it should be just visible. Now lock the cross-slide and continue cutting the teeth until wheel is completed.

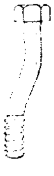
Make sure the cutter revolves at a high speed, at least 2,000 r.p.m., and feed cutter slowly. The writer has found that with a really sharp cutter, only the slightest belt tension is necessary; in fact, on one occasion the belt ran off the cutter spindle pulley and merely made light contact with the polished spindle itself. This increased the revolutions considerably at the cost of decreasing the belt grip to a negligible quantity and, to the writer's surprise, the cutter worked even better than before.

Finally, with regard to lubricating the coned-bearings of the spindle, it has been found best to pack the centre holes of the shaft with a spot of grease before commencing operations, and then to apply a trace of oil with a camel-hair brush at frequent intervals during wheel-cutting.

Not *every* brass alloy appears to be suitable for fly-cutting and the "chippy" variety is far better for this process than the kind of metal which comes off in tightly rolled shavings when being turned. The discs obtainable from Messrs. Smith of Clerkenwell, have proved ideal for wheel-cutting (usual disclaimer) and are sold, the writer believes, primarily for this purpose.

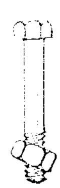
SPECIAL STANDARDS

We have pleasure in presenting to our readers a description of some new and ingenious Standard Parts, designed in the light of many years' experience by a team of aircraft fitters, who for obvious reasons prefer to remain anonymous.



DEADLY NIGHT-SHIFT BOLT
Very useful where holes are slightly out of line. Available in various mis-alignment sizes up to $\frac{3}{4}$ in.

HORSEHEAD HANDLE BOLT
For use where holes have inadvertently been drilled rather close to the heels of angles or brackets



INCLINED NUT
These nuts are available tapped at various angles. The nut is held while the bolt (and the inspector's) head is turned.

HOURGLASS AND SHAMROCK RIVETS
Two rivets whose usefulness speaks for itself.

By courtesy of the De Havilland Gazette

A $\frac{3}{4}$ in. SCALE

GRESLEY PACIFIC

By JAMES PERRIER

The model Pacific being driven by Mr. G. Howell of the Andover S.M.E.

THE description of this locomotive must be prefaced by a statement to the effect that this effort is a " come back " to model engineering, after some very early models, principally electrically driven locomotives, made over 40 years ago, of which many were described in THE MODEL ENGINEER, from 1908 to 1920.

Having retired, after a very busy and long factory life with no time for model making, and having also acquired, lately, a moderately equipped workshop, a start was made on the above, with drawings and castings by Clarkson's of York. The design follows very closely Gresley's original Pacifics, the first to be made in this country (with the exception of the famous G.W.R. *The Great Bear*). These locomotives, with three cylinders, as in the model, provided some careful and close work in $\frac{3}{4}$-in. scale, which called for the skilful use of one of the old $3\frac{1}{2}$-in. Drummond lathes, of which there was some discussion lately in THE MODEL ENGINEER. This one, anyhow, has the centre leadscrew with flat bed and, in spite of its age, over 40 years, was in remarkably good condition, and provided all the turning and *milling* necessary to make and complete the model. The only other tools used, were a $\frac{3}{8}$-in. small drilling machine, and a small makeshift grinder for tools, etc., as well as the usual hand-tools, in the average model-maker's workshop.

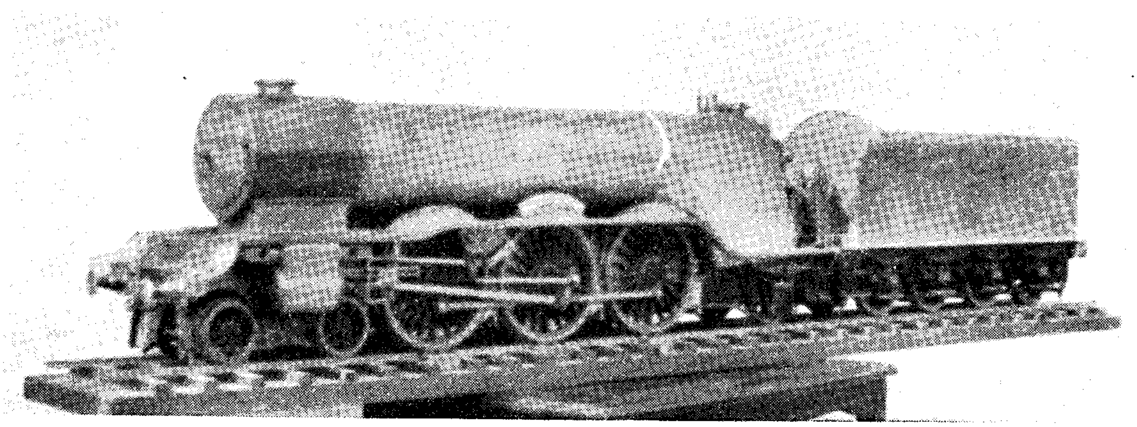
Main Frames

These were cut out by drilling, sawing and filing, from $\frac{1}{8}$-in. black steel plate, to avoid distortion, and for ease of flattening ; all the cast and fabricated stretchers, hornplates, keeps, main bearing blocks were finished by filing, as the lathe was not available for milling, till some time later. The hornplates for coupled wheel centres were arranged accurately and squarely in the frames to within ± 0.002 in. The main bearing axle holes were bored later on the lathe in a dummy horn-block set up, on the lathe faceplate, and were accurately placed in the centre of the bearing blocks, and then springing, keeps, etc. fitted up.

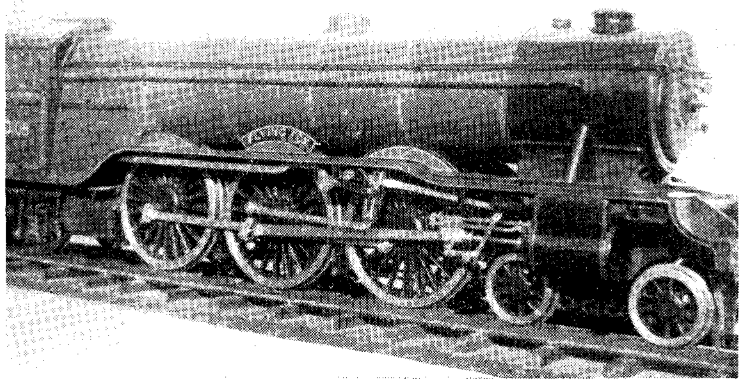
The pony truck axleboxes are the " Cartazzi " type, and slide correctly in angular relation to the main coupled wheels, and are sprung with a coil spring in the dummy leaf-spring castings, as also are the bogie wheels, each with independent springing, bogie frames and axleboxes being made in the same way as the main coupled wheel axleboxes and frames.

Wheels

All wheels were of very good quality cast-iron castings, and were turned to *scale* width, not oversize in width as many designs provide. These look far truer to life, and negotiate fairly stiff curves quite easily and safely. All wheels are forced on to the turned axles, which were turned all over between centres, the crank-axle being made from parts, pressed tight fit, and no other fixing, coupled wheels being all set accurately to the 120 deg. necessary for a three cylinder job, by careful setting up and measurement in all three positions. Dummy strip coupling rods were made to drawing sizes and to $\pm$ 0.002 in., and on erection for test, before cutting the real



Showing the boiler and tender partly assembled



View showing the cylinders and motion

coupling rods to these pattern centres, no trouble at all was experienced. The time and care taken with main bearings centres, main bearing blocks setting wheel angles, and coupling-rod centres, proved the statement that everything works well when correct.

Cylinders and Motion

Cylinder castings are in G.M. and are fitted with slide-valves; these although unlike the prototype, are camouflaged behind the dummy front and rear guide brackets and cylinder clothing. Cylinder ports were cut from the solid casting, by making a template, with which several small holes were drilled in their correct relationship, but were 0.01 in. smaller in diameter than width of ports, the superfluous metal and correct width being exactly sunk with an $\frac{1}{8}$ in. and $\frac{1}{4}$ in. diameter end-mill, set up in the lathe, with correct packing for height and pitch of ports. This was done to ensure the avoidance of the strange shapes produced when end-milling into solid metal. All port faces and slide-valves were lapped dead flat on plate-glass, and are tight and smooth after scores of running hours. No cylinder drain-cocks are provided in the design, which, I think is a serious error. As these were not fitted, as castings did not permit, the locomotive is, when starting, a very "wet lady"; this, will no doubt be corrected later by some means or the other, as the castings and design allow.

The inside cylinder slide-valve derives its motion from the real 2-to-1 Gresley conjugated valve-gear levers and motion, which is worked from the outside Walschaerts valve-gear, and functions very well, in spite of the often disparaging remarks made about this particular type of valve-gear operation. This also means that valve spindles on outside cylinders have to pass through glands at each end, as the 2-to-1 gear motion is derived from the front end of the valve-rods.

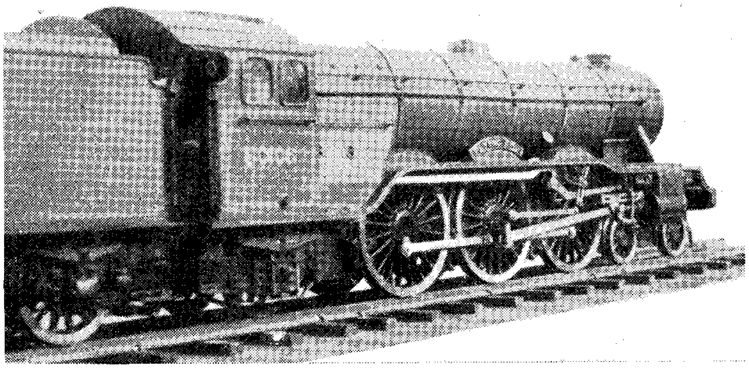
Piston packing is of the graphited yarn type, in a single groove, and all cylinders and both front and rear valve-rods are packed in the usual screwed type of glands.

Another important point left out of the design, is the means to set the internal slide-valve, as with no cylinder drains and the impossibility of exposing the valve inside the steamchest, which is firmly braced between the frames, it cannot be done by sight, as on the outside cylinder steamchests. Therefore, there has been provided two 8 B.A. tapped holes in front and rear inside cylinder covers, so that these can be removed during all valve settings, and an actual air test made of the exact position of the inside slide-valve; and very useful it was, and could be followed in other three-cylinder jobs where there are no cylinder drains.

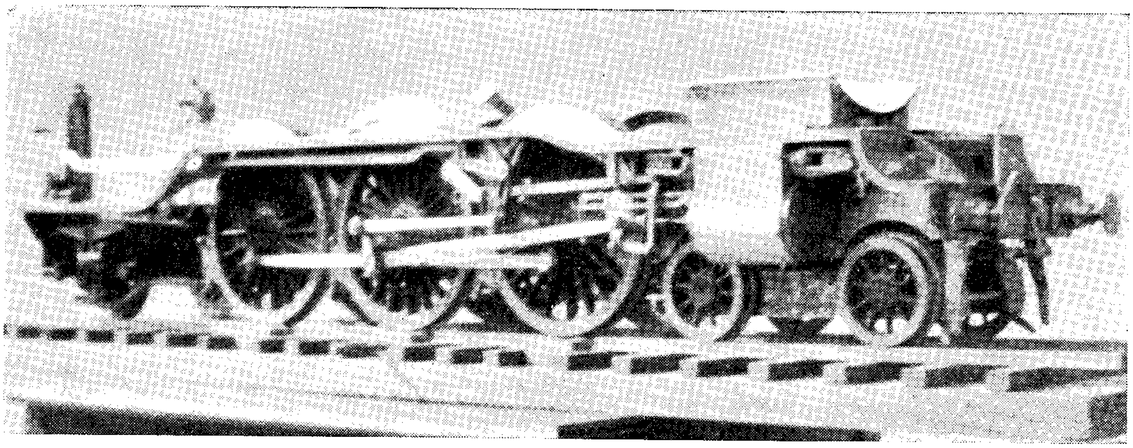
Slide bars, both inside and outside, are of the three-bar type, as in the prototype, with the crossheads a gunmetal casting; this, unfortunately, is unlike the prototype, but would have been too complicated and small to fabricate in steel, if correct proportions were held. All motion work, coupling and connecting-rods, were cut from the solid, with very little filing, all the work of milling, etc., being done on the lathe. The rods are not fluted, as they should be, as, at the time of manufacture, no vertical-slide was available, but this again will no doubt be corrected, later on.

The expansion-links are properly hung on both sides in the cast expansion-link brackets with double trunnions, and all motion has retained its tightness and accuracy, after many hours of hard work on the track. Reversing shaft, rods, and reversing gear in cab are all of Gresley pattern, the reversing wheel in cab being one of the vertical screw-up-and-down type, as in the prototype. Unfortunately, this provided such hard work for the driver, when using a straight up and down track, that it was removed, and a vertical pole lever introduced, so as to avoid one's fingers being really worn out at the tips, when using the correct pattern.

A mechanical cylinder lubricator is fitted in between leading and driving wheels, in between main-frames, and is of the single oscillating cylinder pump type, with the usual ratchet feed, worked off one of the water pump eccentrics (the filler spout and cap can be seen on the off-



Three quarter rear view of the loco



The three-cylinder chassis ready for air-test

side between the two front wheel splashers).

Pumps

Twin mechanical pumps for water feed, are provided between driving and rear coupled wheels, the driving eccentrics being mounted on each side of the inside crankshaft, both have stainless steel rams, and valves, with a gunmetal body casting.

Boiler

Main barrel of boiler is $4\frac{1}{8}$ in. outside diameter $\times$ 16-s.w.g. solid-drawn copper tube, fitted with two $\frac{3}{4}$ in. diameter superheater flue-tubes, and sixteen $\frac{7}{16}$ in. diameter fire-tubes (there is no extra combustion chamber); throat-plate was carefully beaten up to surround base of tube and to wrap around firebox outer cover. This was a difficult piece to fabricate, owing to the two curves in both directions, and no former was possible; it also required annealing some seven times before shape was arrived at. In the case of the inner throat-plate, firebox rear-plate, back-plate, and front tube-plate, patterns were made in wood, and cast-iron castings obtained for flanging the plates, all in 13-s.w.g. copper sheet.

Briggs ring for firehole, and square copper for foundation ring were all made and well fixed everywhere with 3/32-in. copper rivets, $\frac{3}{8}$ in. pitch. All bushes, facings, regulator and stay hole seats, etc., were made of phosphor-bronze and forced in tight; and as, at the time, no equipment was available, either at home, or for many miles around for brazing up the boiler, the whole work of brazing was done most creditably by our good friend Dick Simmonds, the complete outfit being tested hydraulically to 200 lb. for a working pressure of 80 lb. Stays are of copper, well nutted inside and outside and sweated all over.

Regulator is of the "disc in tube type," with bronze and stainless steel fittings, and feeds the twin superheaters header in the smokebox, the twin superheaters being reunited in a Y-fitting, before leaving smokebox to split up again underneath to the three cylinders.

All safety valves, water-gauges, blower (hollow stay tube type), steam brake-valve, clacks, etc. were made and fitted, and the whole assembly rigged up on the bench with a flexible tube attached from the superheater Y-fitting, to the locomotive on a stand, quite separate, and steam raised with a blow-lamp under the firebox, and all testing and teething troubles tracked down, rectified, and further tests made, quietly indoors, without load. In this way, after painting and final assembly, the raising of steam on track outdoors, and testing under load would be sure and certain without anything untoward happening, and as events showed, these preliminary tests were very valuable, and everything went smoothly.

Boiler was fitted with proper clothing, over asbestos lining (1-in. asbestos tape $\frac{1}{8}$ in. thick, wound spirally around boiler) with correct boiler bands suitably drawn up underneath, a correct Gresley snifter, on smokebox, and a deep-tone whistle under boiler, between main frames.

Details

All superstructure, footplates, cab, etc., were fabricated in 21-s.w.g. brass sheet suitably reinforced where necessary, and with cab roof provided with a sliding removable portion, for use when driving. Handrail knobs were turned with a form-tool in brass, drilled in a special jig, and nutted and sweated inside boiler clothing.

Spring buffers are fitted, with screw-couplings, made with U-shaped links, filed from the solid, eyes made flat, and remainder rounded off and folded over U-shape, dummy vacuum pipes, lamp irons, front number plate, etc. Coupled wheel brakes are fitted with steam operating cylinder, which is "space heated" from the outlet of the blow down from water gauge connected to it, for warming-up purposes; brakes are fully compensated with correct shape steel brake blocks. These steam brakes, operated by the driver's brake-valve in cab, are very effective, and pull up locomotive and truck with load, without any slip at all, and in a most realistic manner

An ashpan is fitted over the trailing wheels, and the grate is of the "dropping centre," type, the movable portion being held up by a plug-in pin under the front foundation bar. The boiler is fixed to footplate in the cab and slides in the smokebox end ring which is riveted to smokebox.

Tender

Main frames, axleboxes, wheels, etc., were made by substantially the same process as for the engine, with the superstructure as before made from 21-s.w.g. sheet brass, substantially stiffened where necessary, and in the case of the water tank portion, well riveted up and soldered inside. The outside was finished off with $\frac{1}{8}$-in. half-round

brass beading where necessary. Buffers and couplings are as on the engine, and the drawbar is fitted with buffers between engine and tender.

The tender hand-pump is of the single-stroke type with stainless-steel rams and levers, pins, etc. Gauze strainers are fitted to all water inlets from tank.

Flexible pipes and both rubber and union couplings are used for all the tender connections, to the engine and a set of stoking tools is provided.

All eight wheels of the tender are provided with brakes, operated from a screw-down handle and support on near side of tender.

Painting and Assembly

The most difficult part of the whole work, and one which appears to be the stumbling-block of many model engineers, was the complete dismantling and painting, etc. of all the parts. This, however, was tackled energetically, and all large parts were given two coats of priming paint and four coats of finishing colour, suitably rubbed down between each operation. The paint used was of matt, oil and heat-proof class, and unlike many models, *not* finally varnished and all made to glisten. This has proved its worth, because after countless track-work, the locomotive still preserves a clean and lifelike appearance. After each run, it is really dirty and well stained, but after a good clean up and polish, etc., looks better and more natural every time. The colours used are the British Railways standard livery as first introduced in 1949 for first-class locomotives, i.e. blue, with black and white lining, and yellow figures. The lining was done as far as possible with a drawing pen, and, as far as practicable, scale size ; the black lines are correct $\frac{1}{16}$ in. wide and white lines as fine as possible each side (in the prototype the white lines are only $\frac{1}{8}$ in. wide), also the British Railways " lion " emblem is correctly scaled down, and hand-painted on each side of the tender.

All wheels, frames, cylinders, smokebox, handrails are as shown on the standard livery leaflet, and are dull black.

Running

Steam is raised by means of a small electric blower, which is a 24-volt d.c. ex-aircraft instrument, and when run off the car battery of 12 volts, gives a gentle draw to firebox, the blower being fixed to the locomotive chimney with a push-in tube of exact size. Fire is kindled with paper and wood chips, both soaked in methylated spirits, so as to avoid sooting up firetubes, and good Welsh steam coal is used, put on when wood is glowing ; it provides sufficient steam to work the blower in about 15/20 minutes from cold, and is not too rapid or fierce in starting up.

The locomotive has done many hours of track work, for societies, fetes, etc., and never seems to tire ; pumps see to all water needs except, perhaps, when standing waiting for passengers, when it is necessary to give a few strokes of tender pump to keep up the level, and even with a heavy load on a short track, the valve gear can be well notched up as soon as started.

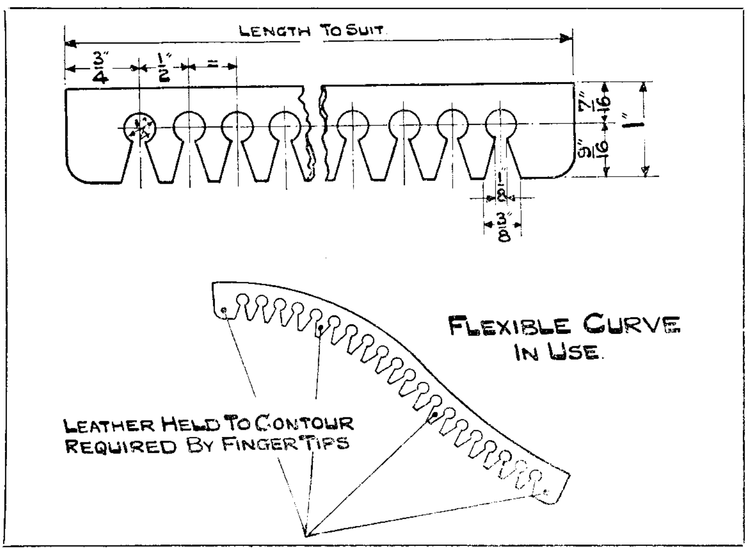
A short track has been provided in the garden for test and trial purposes, and the substructure has been laid down all round to provide a continuous track of 1/10th mile. It is hoped that in the near future the track itself will be completed all round, and, owing to the garden layout, there are several gradients of 1 in 90, 1 in 100, 1 in 110 and 1 in 120. These provide for real driving skill, and at such a time when it will be possible to go continuously all round will be more interesting than a level track. The author is a completely " lone-hand " out here in Ringwood, the nearest clubs being 12 to 20 miles away, and the nearest continuous track nearly 100 miles away, and would therefore welcome visits from any $3\frac{1}{2}$-in. gauge locomotive owners who would care to use the track—all by arrangement.

Since the above was written the continuous track has been completed, and with the editor's permission, will be described at some later date. Trials of the locomotive have taken place many times, and it has been found possible to start and lift up the 1 in 100 gradient a load of over 350 lb., and the highest lap timing for 534 feet (over 1/10th mile) with driver and truck only, about 180 lb., has been 56 sec., giving a mean speed of just 6.5 m.p.h., a *scale* speed of 102 m.p.h., quite a different picture from the ordinary *level* continuous tracks, when in operation!

PERFORMANCE CURVES AND GRAPHS

MOST model engineers these days seem to take a keen interest in the technical side of their hobby, and the need for performance curves and graphs soon becomes apparent. The so-called " French curves " are very useful for drawing these irregular curves, but the writer has found that a more accurate curve can be drawn in much less time with the aid of a leather strip made flexible by punching and slotting as shown in the diagram. The leather should be of uniform thickness and fairly pliable ; a piece of 1 in. single leather belt is ideal for the job. The length can be made to suit, but a minimum of 12 in. is suggested.

—W. E. LOWDEN.



In the Workshop...

ADDITIONS TO A DRILLING MACHINE

BY DUPLEX

ALTHOUGH there are many workers who are content to leave well alone and to go on using a machine tool without making any alterations or additions to the standard pattern, there are, no doubt, others who derive some pleasure in adapting a machine to their particular needs, either with a view to easier handling or for increasing the scope of the machine in some respect.

Clearly the manufacturer has to market a well-equipped machine ; but, quite apart from the increased cost, he cannot be expected to satisfy the whims of each and every user.

A Modified Depthing Stop and Scale

Drilling to a precise depth is a common requirement in the workshop, and this will be facilitated, and time will be saved, if the drilling stop can be easily and accurately set, in order to limit the downward travel of the quill for an exact distance. The Pacera drilling machine, appearing in the illustrations, has proved to be an accurate and versatile machine ; in particular, the refinement of engaging the low-speed drive by the movement of a small lever on the side of the head is an outstanding advantage and saves much belt shifting.

The standard depth stop, shown in Fig. 1, is of the original Driver pattern and consists of a threaded pillar attached to the quill by means of a clamp ring. The pillar passes through a hole drilled in the lug forming part of the head casting, and the downward travel of the quill is limited by the setting of a knurled finger-nut threaded on the pillar and secured by a lock-nut.

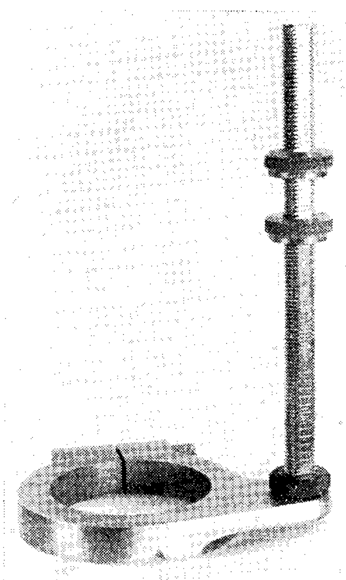


Fig. 1. The standard form of drilling stop and scale

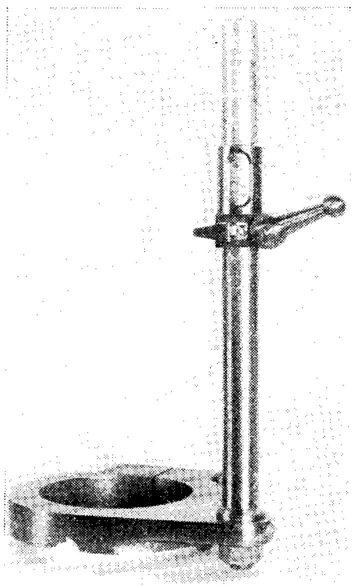


Fig. 2. The new drilling stop

The pillar has flats formed on its two sides, and these are graduated in inch and metric fractions. As can be seen in Fig. 1, the presence of the thread profiles makes the scale less easy to read, and with this type of stop the zero position of the scale is not readily adjustable at the start of a drilling operation. To make for easier working and, perhaps, to satisfy a personal prejudice, a new depth stop of the pattern illustrated in Fig. 2 was designed and fitted. In the accompanying illustrations it will be seen that the pillar (*B*) is again secured in the clamp ring (*A*) attached to the quill, but the lower end of the pillar is given clearance to allow for adjustment after assembly. The sliding index collar (*C*), forming the depth stop, is secured to the pillar by means of a clamp-bolt (*E*).

Moreover, the collar is slit for the greater part of its length, and a feather, carried in a slot formed at the lower end, engages in a keyway cut in the pillar and prevents rotation.

This index collar should be made a close and accurate sliding fit on the pillar, so that on tightening the clamp-bolt the collar is firmly secured, and cannot be pushed

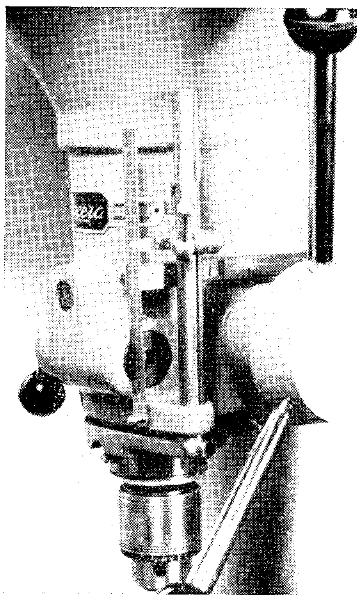


Fig. 3. The drilling stop and scale fitted to the machine

downwards by pressure on the drilling machine feed-lever. In this connection, it might be thought that a purely frictional hold would be inadequate for securing the index, and that some form of positive lock would be preferable. But the sliding collar has the advantage that it can be very quickly set, and, before completing the attachment, a test was made to check the efficacy of the frictional grip.

For the latter purpose, the pillar was mounted vertically on the drilling machine table, and the drill chuck was pressed against a thimble slipped over the pillar and bearing on the index collar. However, the index collar did not shift when drilling pressure was applied just

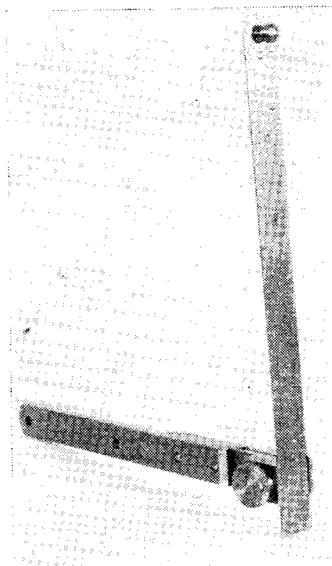


Fig. 4. Details of the adjustable rule-holder

short of bending the feed lever, and far in excess of that normally used for drilling.

The index (*D*) is made up of a sheet steel pointer, engraved with an index line, and a small bracket attached to the side face of the index collar by means of two 8-B.A. screws. The projecting limb of the bracket is slit to take the pointer, and the parts are riveted together.

The Depthing Scale

The bracket (*F*) for carrying the rule that serves as the depthing scale is made in two parts: the shank for attachment to the head casting of the machine, and the head portion in which the rule slides so that it

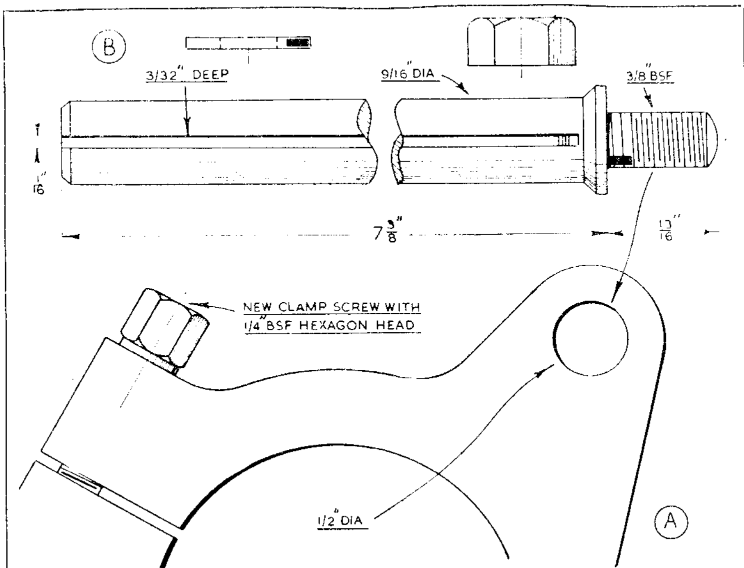


Fig. 5. "A"—the quill clamp-ring; "B"—the pillar

can be clamped in place after adjustment. The rule used is the Rabone No. 25A, 6 in. in length and engraved in eighths and sixteenths of an inch on the two edges of one side face. As this rule is only 20 thousandths of an inch thick, the clamping faces on the head can quite easily be undercut with a small triangular file, thus ensuring that the rule is firmly held when the finger-nut is tightened.

A small finger knob is attached to the end of the rule by making use of the hole already drilled. The rule can be reversed end for end to enable the pointer to register with either the $\frac{1}{8}$ in. or the $\frac{1}{16}$-in. scale graduations.

Setting the Depth Stop and Scale

For drilling a series of holes to a uniform depth, the attachment is

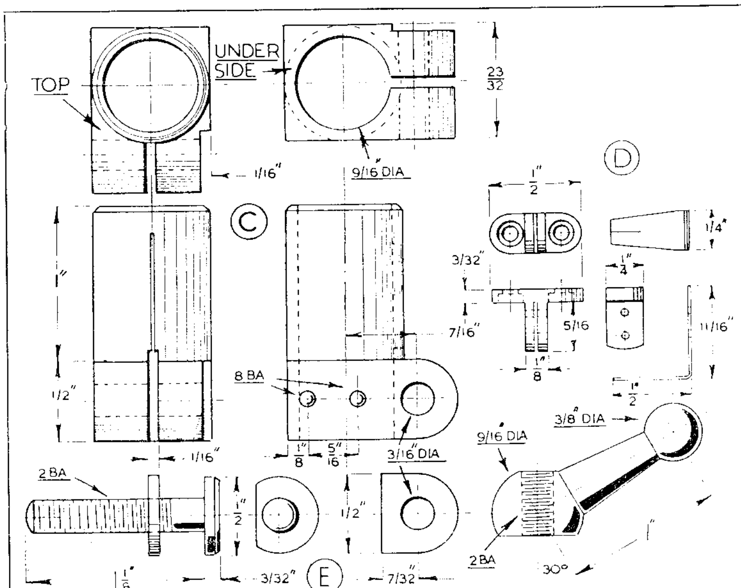


Fig. 6. "C"—the index collar and stop; "D"—the pointer and bracket; "E"—the collar clamp-bolt and key

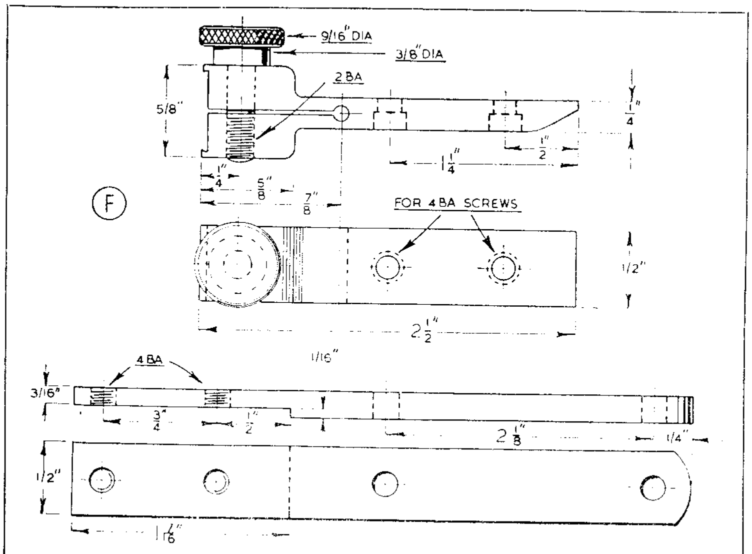


Fig. 7. The rule holder

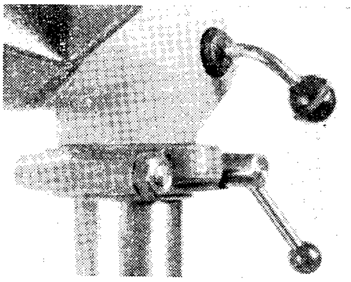


Fig. 8. The table stop-collar in position

set in the following manner.

After the drill point has been brought into contact with the work and the quill clamped, the index collar is moved downwards against the flat surface of the lug on the head casting ; an inch graduation line on the rule is then set to the pointer and the rule is clamped ; finally, the index collar is moved upwards, with reference to the rule, for a distance equal to the depth of drilling required, and the collar is then securely clamped to the pillar. When drilling a single hole to an exact depth, it is quicker to set the rule with any inch graduation line registering with the pointer, while the drill point rests on the work, and then to read off the depth of drilling as the pointer follows the drill down the scale.

A Work Table Stop Collar

When large work is being drilled, it is often necessary to swing the drill table to bring fresh drilling centres into line and, at the same time, to preserve the height setting of the table. If the table is unclamped and moved to one side, there is no certainty that it will not fall, but this difficulty can be readily overcome by fitting a clamp collar to the pillar, and the table can then be swung as often as is needed without affecting the height setting. The collar is shown fitted in place in Fig. 8, and the finished collar and its components are illustrated in Figs. 9 and 10. As both the pillar of the machine and the materials used to make the clamp will vary in size, the working drawings are omitted.

The collar shown was made from a discarded pair of bearing caps used on the main bearings of a tractor engine.

To enlarge the bore to fit the column of the machine, the two caps, after being bolted together, were gripped and centred in the four-jaw chuck and, at the same time, the parts were faced on both sides.

Filed Curved Recesses

As can be seen in Fig. 10, the bore, when enlarged by $\frac{1}{8}$ in. in diameter to fit the column, encroaches for a short distance on the bolt holes ; curved recesses were therefore filed in the bolts themselves to enable the collar to be slipped on to the column.

Filing the bolts in this way had

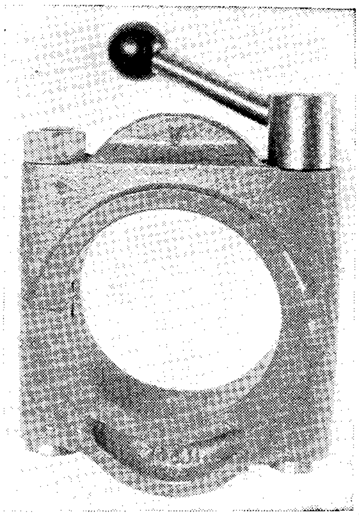


Fig. 9. The finished stop collar

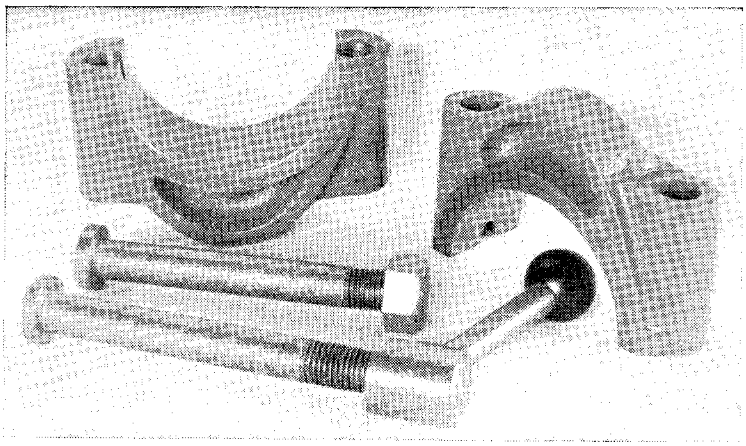


Fig. 10. The stop collar parts

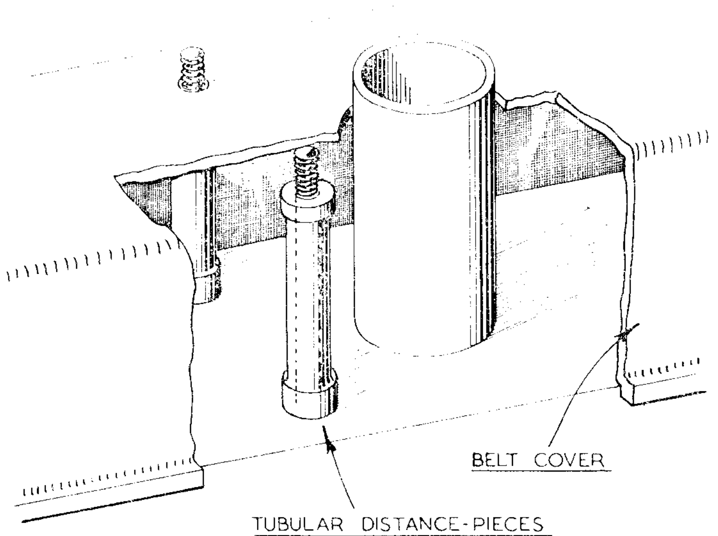


Fig. 11. Distance-pieces fitted to raise the belt cover

the advantage that the bolts, when in place, were thereby prevented turning, and there was no need to fit the usual snugs under the bolt heads.

The cap-nut carrying the clamp lever was first tightened down by gripping it between copper clams in a hand-vice, and the position of the tapped hole at the side could then be marked-out so as to bring the lever into a convenient working position.

Aligning the Driving Belt

Although V-belt pulleys are often run slightly out of line with apparently no great damage to the belt, belt manufacturers insist that correct belt alignment is an important factor in preserving the life of the belt. When the belt alignment of the drilling machine was checked, it was found that a small adjustment was necessary ; but, on resetting the motor, the pulley tended to foul the belt cover. The belt clearance was, therefore, increased by about $\frac{1}{8}$ in. by raising the cover on the tubular distance-pieces illustrated in Fig. 11. These distance-pieces fit over the two studs used for holding down the belt cover, and their upper ends provide abutment faces for the cover and also take the pressure of the two knurled finger-nuts.

FOR THE BOOKSHELF

Pioneers of British Industry, by F. George Kay, F.R.S.A. (London: Rockliff Publishing Corporation Ltd.). 338 pages, $5\frac{1}{2}$ in. by $8\frac{1}{2}$ in. Illustrated. Coloured frontispiece. Price 25s. net.

The story of Britain's leadership in industry often arouses so much discussion and argument that a true appreciation of the initiative and faith of the pioneers behind its growth is apt to be forgotten, if not ignored. The author of this book has done well in setting down, albeit briefly, the work of the early pioneers and inventors in science and technology, whose labours have, in the end, proved so beneficial to us all, quite apart from the separate industries which each was founding. The story, as a whole, is engrossing and illuminating; actually, it dates from early historical times, but the most rapid and numerous advances came between 1765 and 1830, leading immediately into what is now universally regarded as the Industrial Revolution.

The book is divided into four main sections headed, respectively, Power, Manufacture, Transport and Communications, and each of these is sub-divided into a number of chapters, the total of which is 28.

The illustrations are remarkable and have been largely obtained from obscure and unusual sources. But they are as illuminating as the text and add much to the value of the book; we doubt if some of them have ever been published before; at least, in a book of this nature.

The text comprises brief stories of the famous men concerned, anecdotes and sketches of their lives and principal activities, all extremely interesting. It is a good book and one that should be widely read.

Lines of Character, by L. T. C. Rolt and P. B. Whitehouse. (London: Constable & Co. Ltd.) 188 pages, $5\frac{1}{2}$ in. by $7\frac{1}{2}$ in. Illustrated. Price 21s. net.

This book takes us, as it were, upon a tour of the lesser-known railways of the British Isles; true, the greater main lines receive some attention, but the emphasis is on " backwaters " and the very few narrow-gauge lines now existing. There are four chapters devoted, respectively, to England, Wales, Scotland and the Isle of Man, and Ireland. Wherever they go, the authors' enthusiasm and keen perception never flag; always there is something of interest to point out and, in the case of Mr. Whitehouse, record with a camera. There are 66 illustrations, for which Mr. Whitehouse is responsible for all but about a dozen; each has its point, and many of them, apart from recording a train, locomotive, or some other feature, manage to capture a great deal of the intrinsic picturesqueness of different localities.

The text keeps up a sort of running commentary upon anything of interest to be noted, and not a little history is wrapped up in it; the descriptive notes are vivid and entertaining to read, arousing a very strong conviction that, even in these days of motor-coaches and cars, a journey by train almost anywhere is still the best means of seeing the country. It is a book that can be picked up and enjoyed again and again, and although its material may not be exactly new to many readers, it has never been better presented or more fully illustrated.

QUERIES and REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Rotary-Valve Petrol Engines

Can you give me some particulars of a type of internal combustion engine in which rotary valves are used instead of ordinary mushroom-type valves? I would like to construct an engine of this type, but have not been able to find any information about the design. J.H. (Bristol).

There are, generally speaking, two types of rotary valves which are used in place of poppet valves to control the admission of mixture to the cylinder and the escape of exhaust gases. The first type is external to the cylinder-head, and usually of cylindrical form. In the type of rotary-valve engine known as the Cross engine, a valve of this type is used, arranged horizontally over the cylinder-head and driven by gears or chain and sprockets from the main shaft.

Valves of this type have been used on multi-cylinder engines where they can be extended across the full length of the cylinder block. An example of this type of engine is the Minerva-Bournonville engine which was tried out on the Continent some years ago. Another well-known type of rotary-valve engine is the Aspin engine, in which the rotary valve is arranged inside the cylinder and is usually of conical form with a vertical shaft. Although rotary valves have potential advantages over the poppet valve, especially at high speed, there are several difficulties in getting them to work properly, including that of lubricating the valve surfaces, and also avoiding distortion at high temperature.

Corrosion of Aluminium Alloys

I am proposing to build a boat hull from duralumin, but I am informed that this material is subject to corrosion when in contact with water. Will you please inform me whether this is correct, and if so, whether any steps can be taken to prevent the effects of corrosion? H.R. (Weymouth).

Certain aluminium alloys, including duralumin, are subject to corrosion in the conditions stated, but generally speaking, the effect is not very pronounced in fresh water. If the hull is in contact with salt water for any length of time, however, it will be desirable to protect it by painting, or a chemical process such as anodising. As the corrosion resistance of chemically-pure aluminium is extremely high, duralumin is sometimes coated with a layer of pure aluminium, this form being known as Alclad. If the hull to which you refer is a model which will spend most of its time out of the water, we do not think that trouble with corrosion is likely to be very pronounced.

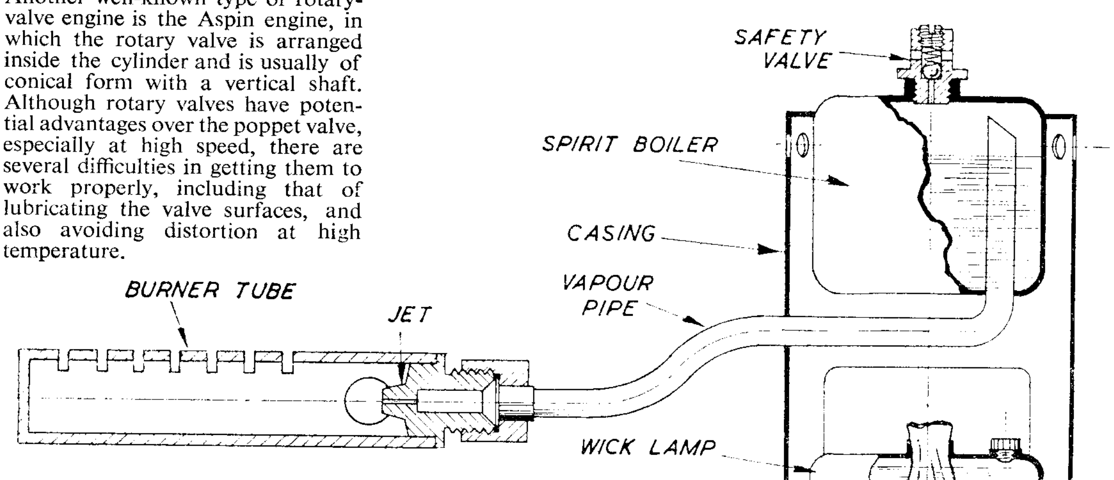
Vaporising Spirit Lamp

Will you please give me details of a type of vaporising spirit lamp which is suitable for firing a water tube boiler as fitted to a stern-wheel paddleboat 3 ft. 6 in. long by 8 in. beam? The space under the boiler is rather limited, and this applies also to the clearances between the tubes and the faceplate, so that it is impossible to use a burner which takes up very much vertical space. L.H.L.R. (C/o. G.P.O.,London).

There are several types of vaporising spirit lamps which could be adapted for this purpose, but one of the simplest is that in which the spirit is contained in a sealed container, and heated by means of a small wick lamp, in order to vaporise the spirit, which then passes in the form of a gas to a burner similar to an ordinary bunsen gas burner.

We show a lamp of this type in our sketch, which is not drawn to scale, and some experimental work may be necessary to get the best results with a burner of this type. The main spirit container may be made of brass or copper, and should be fitted with a safety valve. As shown, the vapour pipe should extend to very close to the top of this container, and it is possible to carry this some distance from the reservoir, though it should not be farther away than necessary.

The design of the burner tube may be varied to suit your requirements, and the exact size of the jet orifice may call for some experimental work. This type of burner would work quite well with the boiler you suggest.



SIMPLE VAPOURISING SPIRIT BURNER